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The population of Chicago, according to a school census just completed, is 1,563,000, against 1,438,000 by a similar census in 1892 and 1,100,000 by the U. S. Census of 1890.

Experiments with oil for fuel on tug boats are being tried at Chicago, under the auspices of the health department, it is said, the desire being to abate the smoke nuisance on the river.

The foundation of the stand-pipe at Bayshore, L. I., the supply pipe of which broke during a gale on May 20, 1894 (Eng. News, May 24), was only 3½ ft. in depth, its diameter on top being the same as that of the superstructure, 20 ft., and at the base only 23 ft. The material of the foundation is of grouted brick. The foundation rests on saturated sand and gravel. It is said that the stand-pipe had settled but 1½ ins. since construction. The broken supply pipe has been replaced, but not with a ball and socket joint, as was proposed at the time of the accident.

A new fuel gas-making process is in operation at Canisteo, N. Y., by which an excellent gas for heating purposes is distributed to consumers at 25 cts. per M. ft. The process of manufacture is apparently a combined coal-gas and water-gas process, and the secret of the low price is that the company has to meet natural gas competition. For lighting, the gas is rather poor, though better than natural gas. In the Welsbach burner, however, it gives excellent results. In gas engines its high calorific power is an advantage, and a 10-HP. engine is said to run with it at a total cost of less than 50 cts. per day of 10 hours. The Canisteo Electric & Fuel Gas Co., which owns and operates the plant, is soon to begin laying mains in Hornellsville to supply gas to that place.

The accident to the U. S. cruiser "Columbia" has been reported on by the naval court of inquiry, which finds that the outer keel plates are bent in for a length of about 80 ft., the maximum depression being 2⅝ ins. The steamer touched some obstruction in crossing Bulkhead shoals in the Delaware River on May 17.

The automatic electro-pneumatic interlocking plant at the new depot of the Boston & Maine R. R., in Boston, was put in service on June 17.

The Pope system of railway car lighting by compressed oil-gas is to be introduced in the United States by the Consolidated Car Heating Co. The system is said to be in use on over 14,000 cars in Great Britain. It was exhibited by the Consolidated Co. at the late Master Mechanics' and Master Car Builders' Convention at Saratoga.

The Haskell "multi-charge" cannon, of which so much was heard a few years ago, is soon to be tried at the Sandy Hook proving ground, according to press reports. The gun was built at the Scott Iron Works at Reading, Pa., a Congressional appropriation of $100,000 having been made to aid its construction.

The recent unusual high water of the Spokane River, at Spokane, Wash., carried away four old highway and one railway bridge, within the limits of the city. These were cheap wooden bridges which needed extensive repairs, or were soon to be condemned, and the loss will not be over $3,500. Two of the new steel bridges were damaged somewhat by the floating wrecks. One tubular pier of the Olive Ave. bridges was pushed down-stream 26 ins. The lower chord of the down-stream truss of the Division St. bridge, two bars, 5 × 1½ ins., steel, was completely broken off. Several teams and street cars crossed this span after the accident before it was discovered and traffic stopped. The above information was sent us by Mr. Geo. J. Loy, Engineer of Bridges, who states that some false report must have gone out because so many bridge companies have written of hearing that the city's new bridges were destroyed.

The most serious railway accident of the week occurred on the afternoon of June 24, at Walnut Creek, ten miles from Chillicothe, O., on the Baltimore & Southwestern Ry. A freight train of 25 cars, which had broken in two, came together on a trestle said to be 50 ft. high. Two cars were thrown from the trestle and three persons who were stealing a ride were killed, two others were fatally and three others seriously injured. Two more "beats" escaped by jumping and three others appear to have been in other parts of the train. ——The explosion of a locomotive boiler at Hiawasse, Tenn., on the Marietta & North Geogia Ry., caused the death of one man and the injury of two others. The boiler belonged to a pusher engine, which was being coupled to a train.

A portable water tower belonging to the fire department of Columbus, O., fell over during practice on June 24 and killed a man in a carriage near by. Three other persons in the carriage escaped.

The "Plymouth," of the Fall River Line of Sound steamers, was pulled off the rocks this week, after being stranded about a week (see Eng. News, June 21). It is reported that there is a hole in the outer hull large enough to admit a man and that the floor of the engine room was so badly damaged that the underwriters advised that the boat be towed to New York instead of driven by her own engines.

A new smoke-consuming furnace has been applied to the boilers of the steamer "Grimm," of the Hamburg-American line, with, it is claimed, astonishing results in fuel economy. From a brief description in the "Engineering and Mining Journal," the device appears to be an application of the down-draft principle, an external furnace of rectangular shape being attached to the front of the ordinary Scotch boilers. The walls of this furnace are stay-bolted water spaces connecting directly to the boiler, a method of construction which engineers generally will look on with great suspicion for use in connection with marine boilers. English and German patents have been issued on the device to Rudolph Muller, of Hamburg.

A decision on water meter patents has just been rendered in the U. S. Circuit Court, District of New Jersey, which holds that the Thomson Meter Co. has been infringing on a patent held by the National Meter Co. The patent in question is No. 379,805, granted March 20, 1888, to the National Meter Co., as assignee of Mr. L. H. Nash. The infringements claimed and held by the court are on the combination or piston formed of hard rubber combined with a skeleton of steel wire or other metal.

Bids for excavating section 15 of the Chicago Drainage Canal will be received by the Trustees of the Sanitary District of Chicago until Aug. 22. The work comprises about 639,000 cu. yds. of rock excavation, 35,000 cu. yds. of earth, and the building of 40,000 cu yds. of masonry retaining wall. The conditions of the bids are given in our advertising columns.

The project for a municipal electric street lighting plant at Toronto, Ont., has been reported on by Mr. E. H. Keating, M. Am. Soc. C. E., City Engineer. Mr. Keating appears to be in favor of municipal ownership and gives the following reasons why municipal plants are probably able to furnish light cheaper than those owned by companies: (1) "In the construction of a municipal station the municipality saves the profit that a private company would of course expect to make. (2) A city is generally in a position to borrow money at a lower rate of interest than a private company. (3) Most of the plants owned by private companies in the large cities were put in some years ago when the cost of electrical appliances was greater than it is to-day, while their efficiency was less. (4) In the construction of a private plant, capitalists will not risk investing money unless they are assured of receiving good dividends, while all that the municipality requires is a sufficient return to pay the cost of running, including interest on the outlay, with a margin for renewals." Mr. Keating estimated that a plant for 1,300 lights of 2,000 c. p. each could be built for $310,000, and operated for $106,000 a year, including interest and depreciation, the lamps burning all of every night. This is equivalent to $82 per year per lamp, against $109 now paid to private parties.

Large rolling mills and arsenals are now being built at Hanyan, opposite Hankow, China, according to Mr. Jacob T. Child, U. S. Consul at Hankow. In the advance sheets of Consular Reports for July Mr. Child gives a rather popular description of the plant, which will cover 70 acres and be fitted with imported modern machinery. The work is being done under the auspices of Change-Taz-Lung, Viceroy of Hupet and Hunan. It is estimated that $3,500,000 have already been expended on the plant and that $1,000,000 more will be required to complete it. A railway 1½ miles in length has been built for the Yangtze River to the works and thence to the Han River. Native iron will be used and rails and small arms made on a large scale. The rails will be used for local railways.

The ordinance providing for a boulevard known as Park Boulevard, to extend from Broad and Filbert streets, opposite the city hall, Philadelphia, Pa., diagonally through the Ninth, Tenth and Fifteenth wards to 25th St., above Callowhill, has been passed by the Philadelphia Select Councils. The proposed boulevard will be 160 ft. wide and eleven squares long, and is estimated to cost $5,700,000 for property damages and $381,000 for tearing down buildings and constructing the new street, a total of $6,081,000. The plans contemplate a wide asphalted driveway in the center and two narrower side driveways, separated from the main driveway by two walks for pedestrians. The sidewalks will be bordered by rows of trees. The ordinance provides that the property owners along the route of the new street shall be allowed three months to vacate their premises, after which time the work of tearing down the buildings shall begin.

The agitation for the elevation of the Baltimore & Ohio railway tracks within the city limits of Washington, D. C., has culminated in the introduction of a bill into the House of Representatives providing for the elevation of the company's tracks from the boundary avenue at the corner of Delaware Ave. to the present station on Jersey Ave., a distance of about one mile. The bill provides for the construction of a viaduct for this distance under which the cross streets are to run, and also for the abolition of the present Y where trains are transferred between the Washington and Metropolitan branches, and requires that all trains be made up beyond the boundary. The passage of the bill is being pushed by the Northeast Washington Business Men's Association, and a sub-committee of the House District Committee is now investigating the necessity of the proposed improvement. The estimated cost of the work is $1,000,000, and the railway company expresses its willingness to carry it out.

The construction of a ship canal across the Maryland peninsula between the Delaware and Chesapeake Bays is again being agitated by the citizens of Baltimore, Md., a mass meeting having been held at that city June 25 to devise ways and means of promoting the project. At this meeting a permanent committee of 21 members was appointed to investigate the subject and to report to the city councils. The movement to construct this canal was started many years ago and in 1878 the Federal Government appropriated money for making surveys which were carried out by Maj. N. H. Hutton. Five routes were surveyed. In 1882 another route was surveyed by Capt. Thomas Turtle, which, with an early survey made by Mr. B. H. Latrobe, makes seven separate routes which have been more or less thoroughly surveyed. The following table shows the lengths of these various routes with the estimated cost of construction and the distance saved over the present route from Baltimore south around the peninsula. The lengths of route are from Baltimore to a common point outside the Delaware breakwater:

Name of route.	Length, miles.	Cost.	Distance saved miles.
Choptank	37.67	$18,500,000	175
Wye	42.99	26,300,000	196¾
Queenstown	53.78	37,250,000	217¾
Centerville	50.95	41,500,000	219
Southeast Creek	38.35	25,000,000	209¼
Sassafras	16.20	11,500,000	195¾
Back Creek	13.63	8,000,000	189

WATER PURIFICATION IN AMERICA.

(Continued from p. 488.)

Pegan Brook Filter Beds, Lake Cochituate, Boston Water-Works.

The Pegan Brook filter beds, designed and built for the Boston water-works in 1893, are probably the first works ever constructed for the purification of a small feeder to a lake, the bulk of the water of which is of a satisfactory character. Pegan Brook runs through the center of the town of Natick and receives in its course the drainage of the streets and perhaps other objectionable matter which cannot be detected. Notwithstanding the fact that all direct drains that could be discovered have been removed by the active work inaugurated

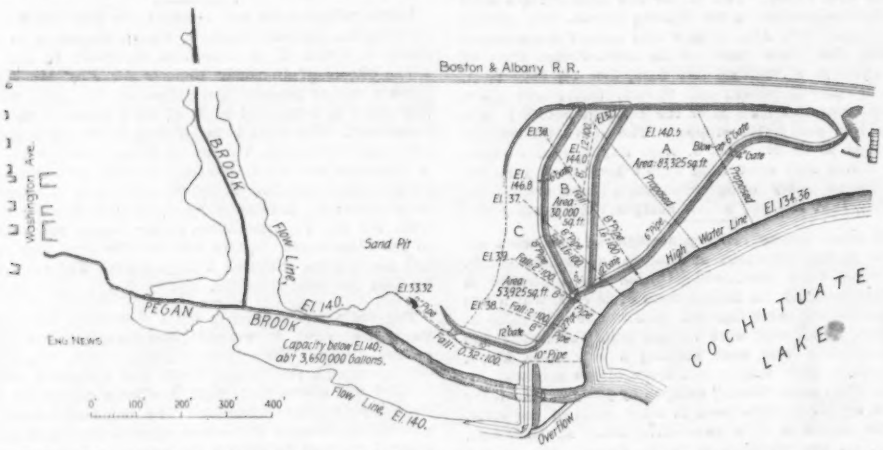


FIG. 32. PLAN OF PEGAN BROOK FILTER BEDS, BOSTON WATER-WORKS.

by the Boston Water Board, it is obvious that the waters of a brook situated as Pegan Brook is must at times be of an objectionable nature. A piece of sandy land near the mouth of the brook was taken by eminent domain, early in the season of 1893, and a contract made with A. Saucier to do the necessary grading and to build the dam for the sum of $5,014. The total cost of the work, including day labor, was $12,585.

The principal features of the scheme, besides the filter beds, are a dam across the brook at its outlet and pumps to lift the water intercepted by the dam onto the beds.

The beds were constructed by removing the soil and putting it into embankments 5 ft. high around and between the beds and by simply leveling the sand. The embankments between the beds are 2 ft. wide on top and have slopes of 1½ to 1. There are three beds, as shown in Fig. 32, at elevations 140, 144 and 146.8 ft. above water-works datum, 134.36 ft. being the elevation of high water in the lake. The areas of the beds are about 2, ¾ and 1¼

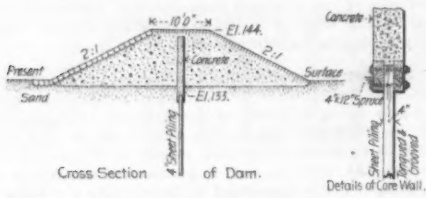


Fig. 33. Cross-Section of Intercepting Dam at Pegan Brook Filter Beds.

acres, respectively, or a total of about 4 acres. The material of the beds to a depth of 8 ft. or so is mostly sand, as fine as is used for making plaster. There are no underdrains beneath the greater portion of the lowest bed, which comprises nearly one-half of the whole filtration area. Underdrains about 100 ft. apart and 8 ft. deep have been laid beneath the upper beds, as shown on the plan, Fig. 32. They consist of about 1,150 ft. of 8-in. vitrified clay pipe, laid with open joints, having canvas wrapped around them. These underdrains, though not necessary for the passage of the water through the ground, enable a part of the effluent water to be got at for examination.

The dam is of earth, about 8 ft. in height above the general level of the ground upon which it is built, and has a concrete heart wall resting on sheet piling, as shown in Fig. 33. The embankment was made of such gravel or other material as was found on the premises. A masonry overflow, Fig. 34, 10 ft. wide, was provided at elevation 139, but stop-planks were put into it, so that the water can be raised much nearer to the top of the dam, which is at elevation 144.

The underdrains were laid by day labor, and also the iron pipes, which are laid under the embankments so as to deliver the water of Pegan Brook at different places upon any of the beds as desired, through the seven gates shown in the plan, Fig. 32. There is nearly 1,000 ft. of 6, 8 and 12-in. iron pipe.

To pump the water onto the beds there is a 25-HP. portable Hoadley engine, made by McLaughlin, driving two 6-in. centrifugal pumps, which have been set up at the south end of the dam and protected by a wooden shed. The lift is about 9 ft. Pumping was begun June 24, 1893. It was stopped from Sept. 11 to Nov. 3, while the flow of the brook was so small that it percolated through the ground back of the dam or evaporated. The amount pumped in a day has varied greatly; it may be estimated at about 500,000 gallons. The capacity of each pump is about 1,800,000 gallons per day. A slight deposit has at times accumulated upon the beds, which have been raked over occasionally and kept in good condition. Chemical and biological examinations of the water of the brook as it goes onto the beds, and of the effluent from the underdrains, have been made from time to time and show good and satisfactory purification.

The averages of four analyses of filtered and corresponding samples of unfiltered water made in 1893 by Prof. T. M. Drown, together with percentage of decrease or increase, are as follows:

	(Parts per 100,000.)					
	Albumin-oid.	Ammonia. Free.	Nitrogen as Nitrites.	Nitrates.	Chlorine.	Bacteria.
Unfiltered water...	.0369	.2139	.0168	.4125	4.75	2,690
Filtered water.....	.0050	.0108	.0219	.4750	4.84	333
P. c. inc. or dec...	— 86	— 95	+ 30	+ 15	..	— 84

The bacteriological results in July, 1893, were better than those for the period, showing removal of 95% of the bacteria of the applied water.

The beds were designed by Mr. Desmond Fitzgerald, M. Am. Soc. C. E., Superintendent of the Western Division of the Boston Water-Works, under the direction of Mr. Wm. Jackson, M. Am. Soc. C. E., City Engineer. We are indebted to both of these gentlemen for the information given above.

STEAM AND ELECTRIC RAILWAYS.*

By Thomas L. Greene.

The development of electric railways into what may be called suburban systems is having certain results not at first foreseen. The comparative cheapness of electric propulsion cannot be denied. One result of the joining of near-by villages and towns by electric roads is that the steam railways, which have for years carried the local travelers who journeyed from one station to another, have felt the competition in some cases seriously. For a ride of but a few miles it is clear that a surface road has a number of important advantages. If the speed be reasonably rapid, and electricity allows of that, the traveler will have to spend very little if any additional time on the journey, and any slight excess of time required is more than made up by the privilege of beginning his journey at any hour which may suit his convenience. Perhaps the electric cars pass his door, while the steam railway station is some distance away. So, too, at his destination, the electric car will land him at whichever portion of the city or village he may wish to go. Possibly in cities this advantage may save him an extra fare which he might have to pay some street road from the railway station. An instance of the effect of this competition is seen in the service between St. Paul and Minneapolis, Minn. The distance between these two cities is about ten miles. The travel between them had been accommodated by local trains run at convenient hours throughout the day by the two principal steam railways. The completion of the electric street railway system between the two cities, however, was followed by such a complete falling off in the travel upon the steam railways that they practically abandoned their local service. In Connecticut, where the steam lines running through populous districts were threatened by the competition of electric roads, there has been a long legislative wrangle over the equities involved.

The situation is such that the steam railways must expect to lose a certain proportion of their station-to-station travel. Rapid transit in the streets and along the highways has become so important from a public point of view that it is not easy to see how the steam roads can retain their old number of short-distance travelers; nevertheless, the competition is unjust. The steam railway has spent large sums of money for its roadbed, equipment and plant, and, as the owner of real estate in the town or county, usually pays a large proportion of the public taxes. On the contrary, the electric road usually pays nothing for its right of way, because the privilege of laying its tracks on the public streets or on the public wagon roads without charge is commonly granted to it; and in these privileges it has a material advantage over the steam road, which, indeed, is often indirectly taxed to support its rival through street or road repairs, or something of the sort.

In another way, also, the electric road has the steam road at a disadvantage. The laws relating to the control of horse cars on the public streets and roads were based upon the assumption that the horse car was an ordinary street vehicle in another shape, as indeed it was. No more precautions were necessary to be taken by the horse-car company than by the owners of private wagons; but rapid transit has changed these conditions, while the slow law has not caught up with them. The fast-moving electric car introduces an element of much greater danger, not only to the pedestrians and trucks upon city streets, but to all who have occasion to drive upon or across the public highway. As yet the electric roads have not been compelled to take any precautions such as experience has shown to be necessary on steam roads, and which the law makes obligatory upon the latter. The electric railways are not obliged to put up any signal apparatus or to protect the public in any way against the new danger—such, for example, as fencing off its tracks, a thing the steam road must do often at large expense. This is particularly true in cases where the electric

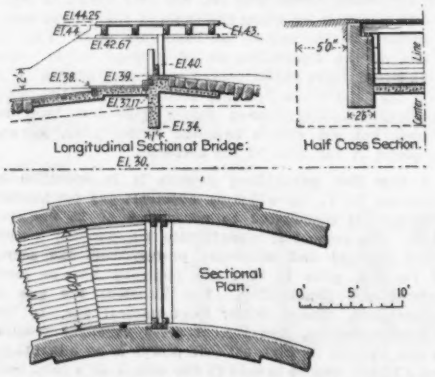


Fig. 34. Details of Dam Overflow, Pegan Brook Filter Beds.

crosses the steam-railway tracks. By one means or another permits have been secured where the electric systems are being extended, to cross the steam-railway tracks at grade. Strangely enough the public mind has not yet awakened to the extreme danger of this new style of crossing. Not only is the possibility of the ordinary collision present, but it has happened that a failure of the motive power at just this point has at times left the electric car and its passengers open to great peril. Commenting on the increase of such crossings in Massachusetts in two years from 26 to 100, the Railroad Commissioners of that state in their last annual report say: "Of all the perils which attend

* Abstract of a paper in the railway number of "The Independent," June 7.

travel on the railroads of this commonwealth, there is not one which, in the apprehension of the Board, is so serious, both in its character and extent, as that here pointed out." Safety both for electric and steam passengers demands the enactment of laws in every state requiring that no electric road shall cross a steam railway at grade, unless the most approved signals and derailing switches are set up.

But while the competition of electric roads between villages is felt by the steam railways which have heretofore carried all the travel, that statement does not exhaust the subject. Even in regard to this same competition it must be remarked that frequent and rapid transit creates travel, and that more people journey from village to village under those circumstances than would take the steam trains if the latter were the only means of inter-village conveyance. More than that, it is highly probable that the effect of the extension of electric roads outside of cities will in the long run benefit the steam railways and facilitate their business. Not every electric road competes by running alongside a steam railway. A great many of them are built to connect distant villages, which have no steam communication, directly with some railroad station. In all such cases, the value of the electric roads as a feeder of the steam railway is rightly considered great. The demand for electric connections is sure to be heard from all the interior towns and villages of local importance. It is possible that the expansion of the new system of street and road transportation, when once extended into the rural districts generally throughout the country, will have important effects upon our political economic problems as well as upon the revenues of the steam railways, which must continue to be the only method of travel for longer distances.

It is within the range of possibilities that electricity may prove itself capable of benefit to the steam railways in another way also. The steam railways are now being solicited by the Department of Agriculture to give their aid to a movement for the improvement of the common roads throughout the country. This claim upon our great railway systems for help in road improvements has good sense in it. Anything which would reduce the expense to the farmer and thus give him larger earnings from the sale of his products will help the steam railroads also which are dependent upon farming for a large part of their traffic. The cost of drayage of farm products from the fields to the railway station over bad wagon roads forms a very serious item in the expenses of the farmer. Good wagon roads would reduce that expense; hence, the movement for the improvement of common roads has a basis in good business sense. It is possible that in time this cheapening of the cost of drayage from the farm to the station may be further reduced by the application of electricity; possibly through the medium of these very same electric roads. Cheap tracks could now be put down upon any highway, which, by means of electric propulsion, could haul produce from the farm to the railway station; the drawback is that the neighboring farms do not furnish traffic enough to support such a railway from products alone. We often hear, however, of electric roads which are chartered and allowed to carry both passengers and freight; and it is within the range of possibilities that some means will yet be devised which will furnish to the farmers a cheaper transportation of their loads of hay and grain to the railway station than even good wagon roads and broad-tired vehicles can furnish.

It is possible, too, that through this development some practical means of furnishing power to the farmers may be devised. The saving of labor on farms, of which we have heard a good deal lately, has been accomplished solely by the invention of machinery through which one man is enabled to do the work of many men by substituting horse for human power, and it may be that in this direction our next great agricultural improvement will come. If we can furnish mechanical power for the various operations of farming when and where it is wanted, and in such a shape that it can be of practical use, we will have taken a long step forward. It is possible that this step may be taken in some way through electricity, and perhaps we may attain it through the introduction of the electric power along the country roads where the electric railway has been introduced. Every important step of this sort is to be encouraged by the steam railways.

MAKING CONCRETE FOUNDATIONS IN QUICKSAND.

An ingenious method of making stable foundations in quicksand, invented by Mr. Robert L. Harris, M. Am. Soc. C. E., was described and illustrated in our issue of April 28, 1892. The method is especially adapted for putting down foundations in copious water-bearing material, where excavation in open pit would be difficult or impossible. It consists briefly in driving down pipes, some distance apart, to the quicksand stratum, and connecting the alternate pipes to a pump, by which a strong current of water is forced underground and rises as flowing wells from the other pipes, bringing with it a large volume of sand. This is continued until an underground chamber is excavated, and by transferring the suction hose to a tank of cement grout the underground cavity is then filled with cement, which soon sets, forming a concrete.

THE HARRIS METHOD OF MAKING FOUNDATIONS IN QUICKSAND.

The accompanying cut, reproduced from a photograph shows a recent test of this system. Pipes were driven at the corners of a hexagon, as shown, about 7 ft. in diameter and to a depth of 17 ft. beneath the surface and 11 ft. below water level. Clear water was then forced into three of the pipes from hose connections, and water carrying sand can be seen flowing from the other three pipes. After a continuous boundary cavity was thus excavated, hose was connected to all six of the pipes, and the sand and water were forced up through the center pipe (shown capped in the photograph) until a clear flow of water was secured. The interior of the cavity was then agitated by currents of water to put the sand in suspension, and the suction hose was then transferred to a grout tank and the grout was forced in until it appeared at the center pipe. The whole was then closed and placed under pressure until the cement had set. The result was the formation of a block of concrete practically filling the cavity and forming a stable floor.

Mr. Harris is making a special study of quicksand and methods of dealing with it, and would be pleased to receive information from any one engaged in work in which quicksand gives trouble. His office is at 1 Broadway, New York City.

BRAKESHOE TESTS BY THE MASTER CAR BUILDERS' ASSOCIATION.

One of the most valuable reports presented at the convention of the Master Car Builders' Association, held at Saratoga last week, was that of the Committee on Laboratory Tests of Brakeshoes. This committee was appointed in connection with the committee to make the road tests on brakeshoes, and the idea was that the two should work in conjunction in that the results obtained by one should be compared and checked with those of the other, but should at the same time carry out their respective duties separately. Both committees presented preliminary reports only, as noted in our last issue. The report of the Committee on Laboratory Tests especially was confined to a description of the apparatus to be used in making the tests and the rules laid down for conducting them. This apparatus is, perhaps, the most complete ever designed for the purpose, and we present the description given in the report nearly in full, as follows:

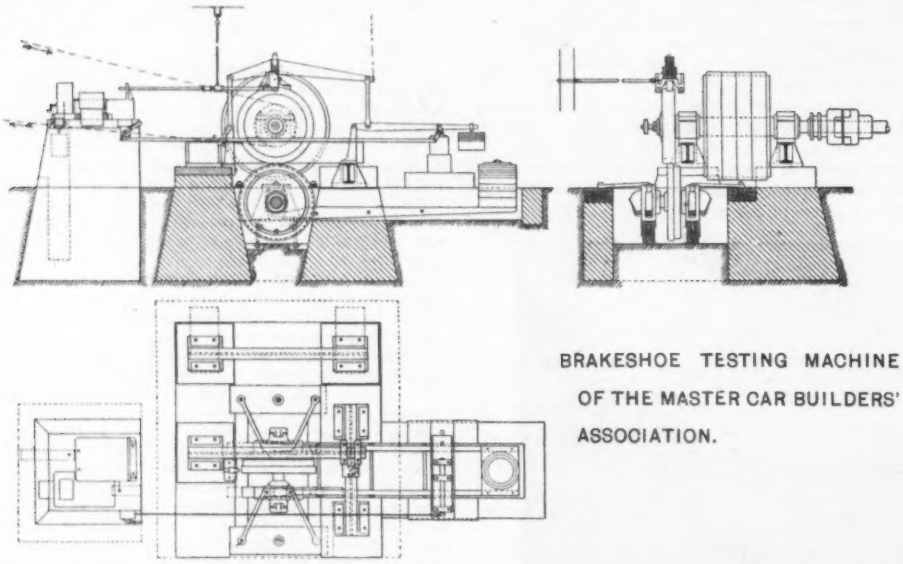
In order to reproduce the conditions of a moving car in a laboratory test, it was first necessary to provide an apparatus capable of accumulating an energy corresponding to that of the car, and to transmit this energy to a car wheel so that through the application of a brakeshoe to the same, this energy could be destroyed, and, in fact, the same action take place as when a brake is applied to a wheel under a car. The apparatus designed for this purpose consists of a flywheel cast in three parts, and steel tired, upon the axle of which the car wheel is attached at one end, the whole resting in two journal boxes securely supported on heavy foundations. The other end of the axle is connected by means of a clutch to a shaft for carrying a pulley to which the power of the driving engine is transmitted through a belt. When the engine is started, and the flywheel has been brought up to the speed at which it is desired to make the test, this clutch is thrown out of gear, and the engine is stopped. The flywheel in the meantime continues, through its own impetus, until stopped by the frictional resistance of the brakeshoe. The arrangement for applying the brakeshoe to the wheel consists of a combination of two levers of the second class, to the first one of which the brake head is attached in such a manner that by means of an adjusting device the wear of either the brakeshoe or the wheel can be readily taken up. At the free end of the second lever the weights which furnish the braking pressures are suspended. The arrangement can best be understood by referring to the general plan of the apparatus shown in the accompanying cut.

The brakeshoe is keyed to the brake head, as in ordinary practice. From a point on the brake head a connection is run to an apparatus described below for measuring the friction between the shoe and the wheel. In order to promote accuracy, steel pins are used in the joints, and the brake lever rests with the knife edge only upon the brake head. When the brakeshoe is to be relieved from contact with the wheel, a block and tackle are attached to the other end of this lever, but for the purpose of applying the brakeshoe quickly, and without undue jar, a tripping arrangement has been devised by which through a light touch upon the handle the pawl supporting the brake lever is disturbed in its equipoise, and the sinking of the lever lets the brakeshoe down upon the wheel. In connection with this lever is a circuit-breaking device which registers the application instantaneously, as will be described further on in connection with the other measuring apparatus. Below the car wheel has been sunk a pit in which, resting upon sills, is a twin lever suspending a pair of journal boxes sliding in pedestals, and these boxes carry a wheel with its axle, as shown in the cut. This wheel, which is steel tired, and has a tread corresponding to the profile of a rail head, is forced up against the car wheel by means of weights placed upon the other end of the twin lever, and is intended to represent the reaction of the rail upon the wheel. This track wheel or idler obtains its rotary motion through friction with the car wheel. Its energy is necessarily small, and it is not expected that it will produce the sliding movement which takes place while making stops in actual service, for it does not come within the scope of this committtee to investigate the action between the wheel and the rail, except as far as it may influence the metal in the tire of a car wheel, which might directly affect the wear and friction of the brakeshoe. As this influence has not yet been established beyond doubt, the use of the idler is conditional, and in the calculations of the machine this has been taken into consideration by due modifications where the absence of the idler would bear any influence upon the results.

As it is necessary to obtain accurate records of the tests, a great deal of care and ingenuity has been expended in providing exact measuring apparatus. In order that the provisions of the committee shall be carried out, the following records have been required:

(1) The speed of car wheel at the time of application of the brake; (2) The variation of speed from the moment of application until a state of rest ensues; (3) The friction between a wheel and the shoe during the same period; (4) The time elapsed during this period; (5) The wear of the shoe and of the car wheel, and (6) The heat developed in the shoe through friction.

The arrangement of the various contrivances for obtaining these data are not shown in detail. They are grouped together on a heavy cast iron bed plate, resting on an independent foundation, so as to avoid vibrations, and are within reach and control of one operator. The apparatus for measuring the friction between the brakeshoe and the wheel consists of a dynamometer constructed on the same principle as that in the Emery testing machine. The connection with the brake head previously described is made by means of pull rods and yokes, and acts upon a lever of the third class bearing upon the spring, the deflection of which furnishes a means of measuring the pull caused by the friction. As this deflection is necessarily very small, the lever



BRAKESHOE TESTING MACHINE OF THE MASTER CAR BUILDERS' ASSOCIATION.

is extended beyond the bearing point, and the increased motion thus obtained at this end is reproduced on a still larger scale by the introduction of another lever actuated by the first one, so that a ratio of 1 to 65 is had, or, in other words, the movement of the free end of the second lever is 65 times that of the brakeshoe. From the junction of the first and second levers runs a connection to a dash pot, the object of which is to modify the vibrations of the levers and steady their motion. The free end of the second lever is attached to a small carriage on which a marking pen is mounted, and this carriage rides in the grooves of a track parallel to a revolving drum carrying the paper upon which the pen registers the movements of the brakeshoe, and therefore the friction.

The drum obtains its motion from a chronograph. It is driven by a weight through a train of wheels, and is controlled by a governor constructed on the basis of the conical pendulum, by means of which a uniform speed is secured. The paper on the revolving drum is unwound in a continuous band from a supply drum, by means of a friction drum holding it against the first one. Opposite to the track of the carriage for the dynamometer pen is another similar track with a carriage, on which is mounted another pen, which upon the same paper traces a line representing the speed of the car wheel at all times. This carriage is impelled by a Boyer speed recorder, especially designed for this service. It is driven through a sheave connection, directly from the main axle, and to the wire running from its piston to the indicating gage is attached a carriage upon which the pen is mounted. Another pen attached to the armature of an electromagnet operated by a closed circuit indicates the moment of application of the brake through the assistance of the circuit breaker previously referred to, by punctuations upon the paper of the same revolving drum.

The wear of the brakeshoes will be ascertained by means of careful weighing before and after each trial. In tests during which the friction will develop a heat of sufficient intensity to affect the surfaces in contact, a pyrometer or thermometer will be used to observe the rise in temperature.

The tests will correspond to the conditions of passenger and freight car service. In the passenger service tests, both a steel-tired wheel and a chilled cast iron wheel will be used, and these will be run at speeds corresponding to 100, 50 and 25 miles per hour. The brakeshoe will be applied with a pressure equal to 50% of the collective weight represented by the flywheel and other revolving parts. The freight tests will consist, first, of ordinary service tests at 50, 25 and 15 miles per hour, with a chilled cast iron wheel used throughout, and a braking pressure corresponding to 70% of the weight of empty cars; and, second, of an endurance test representing the conditions of a train going down a long grade, and retarded in its progress by means of the brakes, so that a uniform speed of 15 miles per hour will be kept up. The arrangement of the apparatus makes it impracticable to vary the braking pressure during this test, and the uniformity of speed will therefore be maintained through a governor on the driving engine controlling the power of the same. The braking pressure may thus remain constant, and it will be that which will be required on a 2% grade, with a constant coefficient of friction which in our calculation is assumed to be 0.233, this being the mean of 78 experiments conducted by Capt. Douglas W. Dalton on English railways. Each brakeshoe will be subjected to all of these tests in regular order, and to secure accuracy in the records each test will be repeated at least once.

In addition to the above, other tests will be made in which the pressure of the brake blocks against the wheel, the speed and the time will be varied by regular graduations, so as to determine the laws regulating the friction under all conditions practicable.

AN ELECTRIC SIGNAL FOR HIGHWAY CROSSINGS.

An automatic audible signal is a very desirable device for use at grade crossings of railways and highways to give notice of the approach of trains and such devices are already quite extensively used, particularly in suburban districts. The signal which we illustrate this week is in use on the Pennsylvania system, the Western Maryland R. R., the Long Island R. R., Chicago & Grand Trunk Ry. and other roads and has proved satisfactory after two years' service.

The motive power of this signal is the Edison-Lalande battery of eight one-gallon jars, which only require to be refilled about every six months.

The operation of the apparatus is very simple. The track instrument for single track roads, Fig. 1, has two concussion bars, A and B, shaped so that when a train is approaching a crossing the bar B is depressed and depresses lever C, which is parallel with lever D, but is partly hidden in the cut. This

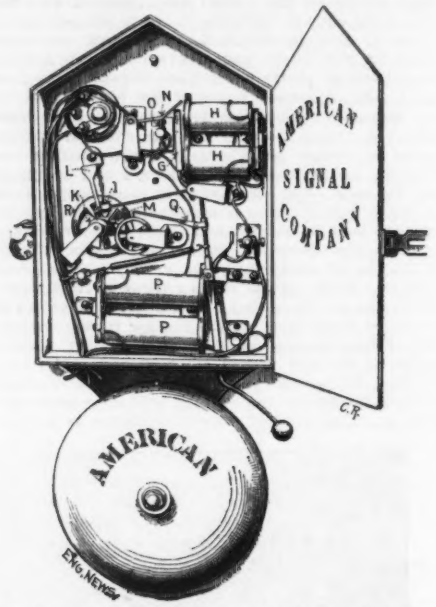


Fig. 2. Gong and Sounding Apparatus of Electric Signal for Highway Crossings.

lever releases the latch E and causes it to pass under the end of the mercury tube F. The second bar A is next depressed, which acts upon lever D, tilting the mercury tube F and making the contact. When a train is leaving a crossing (on single track) the opposite bar A is depressed, which causes the latch E to pass over, instead of under, the mercury tube F and prevents the closing of the current and the sounding of the bell. The double track instrument has but one concussion bar, A, which is depressed and acts upon lever D, which tilts the mercury tube, allowing the mercury to pass to the end of the tube and make contact.

The bell and its sounding apparatus, Fig. 2, are placed at the crossing. When the circuit is closed at the track instrument the armature G of the signal is attracted to the magnet H. As the armature moves the detent hook I is raised out of the notch in the drum K and held suspended by the spring L until it is released by the trip pin M, when it again falls on the drum K. When the armature G is attracted to the magnet H the hinged contact plate N, which rests upon it, falls to the contact point O, causing the current from the battery to go to the magnet P, operating the bell and ratchet pawl Q.

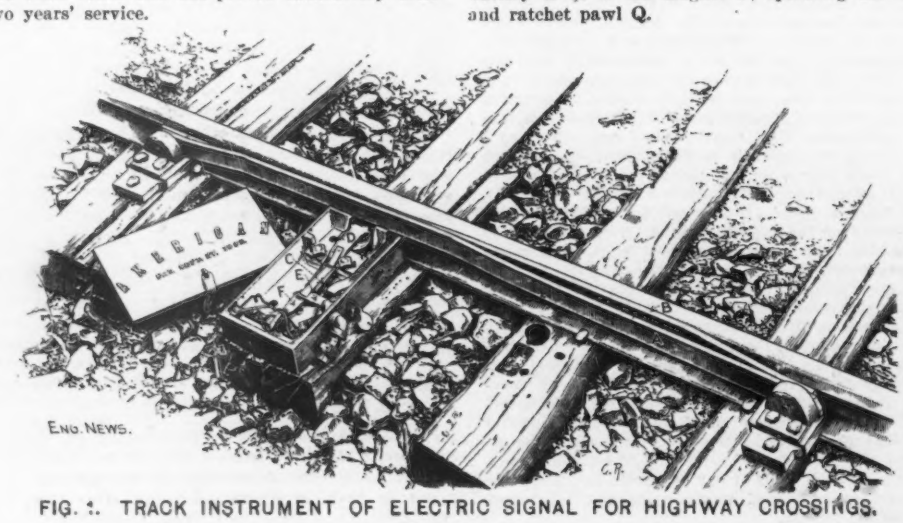


FIG. 1. TRACK INSTRUMENT OF ELECTRIC SIGNAL FOR HIGHWAY CROSSINGS.

As long as the detent hook I rests on the drum K the armature G cannot fall back far enough to break the contact between N and O, consequently the bell must ring until the detent wheel R has made an entire revolution, when the hook will fall into the notch and the circuit be broken and the bell will stop. Should it happen that a train reaches the circuit closer on one track when another train has nearly reached the crossing on another track the detent wheel R will make a second revolution, causing the bell to ring just twice as long as it would had there been but one train.

The signal is manufactured by the American Signal Co., of Baltimore, Md., and we are indebted to Mr. G. W. Smith, General Manager, for photographs and description.

APPARATUS FOR BORINGS FOR THE DIAMOND SHOALS LIGHTHOUSE.

Boring operations to determine the character of the material of the Outer Diamond Shoals, off Cape Hatteras, North Carolina, were made in May, under the direction of the Lighthouse Board, as noted in our issue of June 8, and we are indebted to Capt. Philip M. Price, U. S. Engineers, Engineer Secretary to the Board, for drawings of the apparatus used and a copy of the report made by Mr. J. E. Rettig, Superintendent of Construction, who was in charge of the work. The plans were prepared under the direction of Capt. F. A. Mahan, U. S. Engineers.

The framework of the structure, as shown in Fig. 1, is composed of columns, sockets, struts and tie-rods, framed in the form of a square skeleton prism, 20 ft. square and 32 ft. high, this structure being suspended by 16 bolts 1½ ins in diameter, passing through the flanges of cast iron nuts provided on the upper ends of four wrought iron piles. These piles pass through the columns and have disks at their lower ends. They are sunk 13 ft. into the shoal. The framework supports a platform, from which the boring apparatus was operated. The pipes and boring tools were handled by a derrick placed on the vertical axis of the structure, and the water, under pressure, for sinking the piles was conducted to the apparatus by a hose and pipe branch. The structure was floated by two wooden pontoons and towed to the site, where it was sunk by admitting water into the pontoons, which were then cut loose. The structure was then secured by sinking the four piles by the water jet and then bolting the nuts of the piles to the sockets at the upper end of the structure.

The boring apparatus consists of three pipes, driven by water jet, provision being made for the use of boring tools in case of any hard material being met with. The 5-in. pipe was sunk to a depth of 40 ft., the 3½-in. pipe to a depth of 78 ft. and the 2-in. pipe to a depth of 114 ft. below the surface of the shoal.

The columns and struts are of wrought iron, 7⅝ ins. outside diameter and ½ in. thick, with collars shrunk on and secured by studs. Each of the four piles is made of two pieces of 6-in. rolled iron, welded together and made straight and of such size as to pass through the columns, leaving a clearance of ⅝ in. Each pile has a turned screw, which fits a bored wrought iron clamp attached to the pontoon, each clamp being made in two pieces, with two ¾-in. bolts. Each pile has a jet pipe composed of two lengths of 3-in. wrought iron piping, with elbows and couplings, the lower end of the pipe being well fitted into the tapped boss of the disk. The metal work was thoroughly cleaned and dried, and given two coats of red lead ground in linseed oil.

In Fig. 2 is shown the position of the structure as now erected, and the following is an abstract of the report made by Mr. Rettig on the placing of the structure and the borings:

I have the honor to transmit herewith my report upon the work recently performed in connection with the examination of the bottom of the ocean at the Outer Diamond Shoals off Cape Hatteras, N. C., in long. W. 75° 24′ (40″) and lat. N. 35° 08′ (23″); a place previously marked by two second-class nun buoys, after a survey of the extreme southern end of the shoals had been made by the U. S. Coast and Geodetic Survey.

The framework and boring apparatus by means of which the work has been accomplished were designed by the Board in September, 1893; the ironwork for the apparatus was manufactured in Lebanon, Pa., and the pontoons and lumber were furnished by a Baltimore firm. These materials, which were furnished under two different contracts, were delivered during April, 1894, at the Lazaretto Lighthouse Depot, Baltimore, where it had been contemplated to erect the apparatus and transfer it to the water. However, as it was learned upon inquiry that suitable shears and other necessary conditions for launching the structure could only be secured at the yards of the Newport News Shipbuilding & Dry Dock Co., Newport News, Va., the carpenter work only, comprising the fitting of the timbers to the framework, was performed at the Lazaretto Depot, when, after the completion of the same, the materials and also the two pontoons were loaded on a barge, which measured 23½ ft. by 70 ft. on the water-

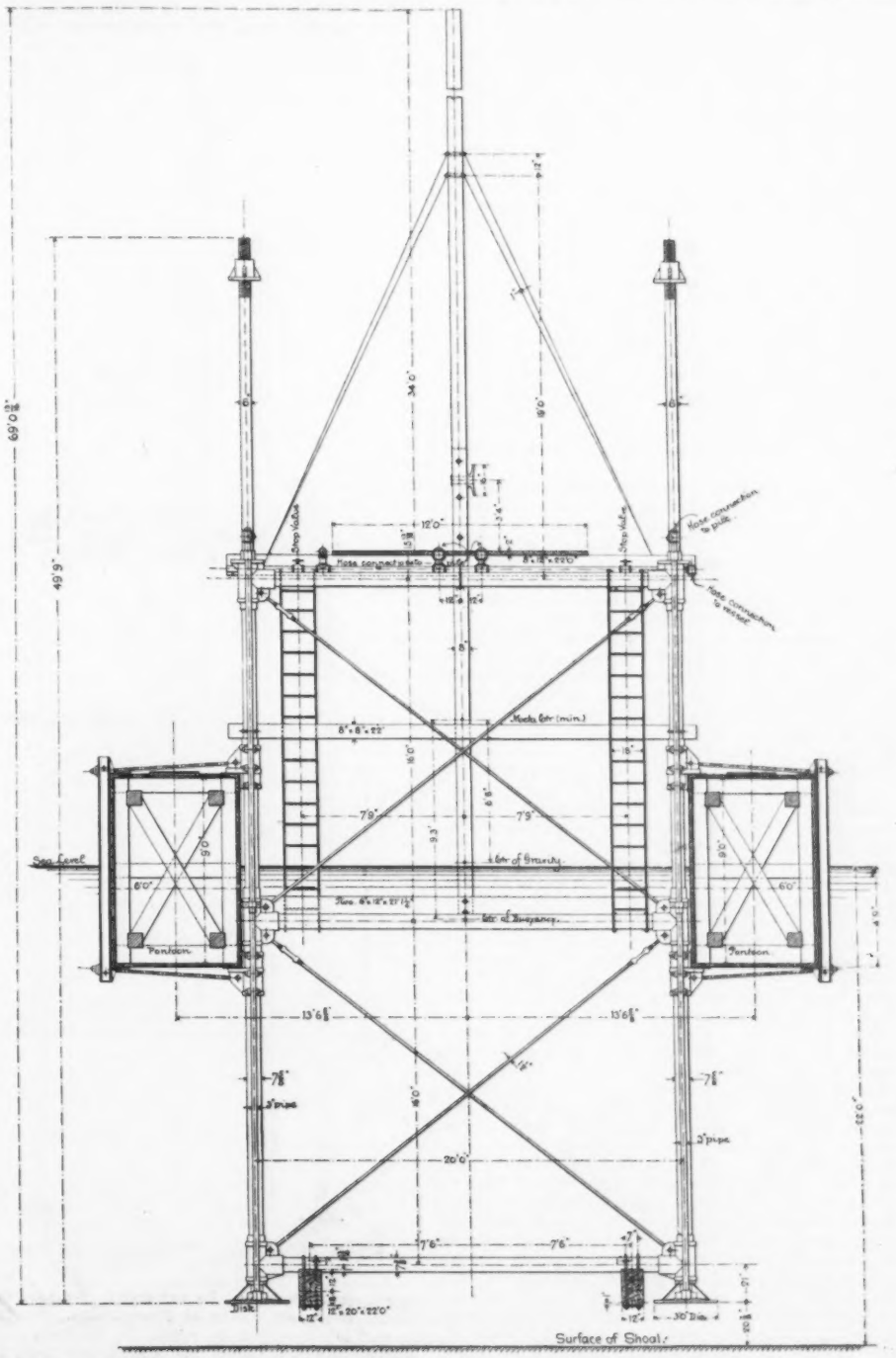


FIG. 1. FLOATING OUT THE STRUCTURE FOR BORING APPARATUS AT THE OUTER DIAMOND SHOAL.

line, and had a displacement of 72 tons, due to its own weight. The loaded barge left Baltimore on May 10, and it arrived at Newport News at noon May 11, when the erection of the apparatus upon the deck of the barge by means of a suitable derrick of 12 tons lifting capacity was commenced with.

The different parts of the ironwork had been well constructed and fitted, and not the slightest delay, so often due to defective workmanship, occurred. On Thursday, May 17, the complete apparatus, with pontoons connected in their places, weighing 46 tons, was lifted off the barge and successfully transferred to the water by means of the 100-ton shears at the shipyard. The undertaking so far came out successfully and in accordance with the various calculations made for determining the stability of the loaded barge, which had been doubted. Knowing, however, that with the structure completely erected on the barge, the metacenter of the floating mass was 8 ft. 6 ins. above the center of gravity of the same, and that it would have required a maximum moment of 206 ft.-tons to upset the barge, I determined to proceed in the way it had always been contemplated, and complete success crowned the result. After launching, the mast surmounting the framework was put in place; and all necessary water pipes and rubber hose were placed in position. The pontoons were well secured to the structure by four 1¼-in. tie rods, and on Saturday, May 19, the apparatus was ready for sea, drawing 21 ft. of water and having a metacentric height of 6 ft. 8 ins., which proved, on the way to the site, to give ample stability to the floating mass.

On May 23, a steamer of the Merritt Wrecking Co. arrived at Newport News, and it required but a short time to drill the crew for the work to be performed at the site. At 1 p. m. on Wednesday, May 23, the steamer

started, having a 7½-in. tow line, connected to the structure by a long rope-bridle. The speed was from 3 to 3½ miles per hour. Nothing unusual occurred on the journey, the apparatus floated and towed like a well designed vessel, and except for the leakage of the pontoon on the port side of the structure, which made water at the rate of ¾ cu. ft. per hour, and which was pumped at sea every twelve hours, the apparatus required no special attention. In leaving the capes a heavy swell from an easterly direction, caused by the storm on May 21, was met, but had little effect upon the structure.

On Friday morning, May 25, we arrived at Cape Hatteras. I located the position of our steamer and we proceeded on our new course towards the buoys which came in sight at 1 p. m. The tide and the sea were not suitable at the time for grounding the structure, and I contented myself on that day with taking soundings on a line from deep water to the buoys in range of the main light at Hatteras. Finding that the soundings were exactly as indicated in a letter from Lieutenant-Commander Garrett, U. S. N., we anchored at a distance of about two miles from the buoys on the east side of shoals, where we remained, not having the least anxiety about bad weather, until Sunday morning at 7 o'clock, when all indications and conditions of the weather were such that the grounding of the apparatus could be attempted. High tide occurred at the shoals at 11:30 a. m. At 7 a. m. everything was ready for work, and the anchors for mooring the steamer alongside the structure after it had been grounded, were ready to let go at a moment's notice. At 11 a. m. the men were stationed on the structure and at 11:30, when a moderate swell and only a choppy sea, but a strong current prevailed around us, the apparatus struck bottom, the valves in the pontoons were opened and within 15 minutes the pontoons were liberated and floated off in a southeast direction, impelled by a current too strong to enable us to save them without the sacrifice of much valuable time.

Meanwhile the steamer's crew unfastened the tow line and placed the moorings at the corners of a square having a circumscribed circle of from 600 to 700 ft. diameter with the structure located at its center, and at 1 p. m. the vessel was securely moored alongside the framework and ready to furnish water under pressure through two 2½-in. hose for driving the four piles by which the structure was to be secured to the bottom. The first pile was sunk to the contemplated depth of 13 ft. into the sand and secured to the structure within 10 minutes; the second pile went like the first; the third was bearing upon the sand, and as the water would not discharge from the openings of the lower disk, it required underwashing by a 2-in. pipe to start circulation, and when this took place, the third pile went successfully into its place. The fourth pile started all right, but in its fall broke the T of the pipe which conducted the water to the disk. The T was replaced by another, the disk, around which the sand had settled, was underwashed like that of the third pile and the pile went down like the others, and at 2 p. m. the structure was secured and stood firm on the shoal. The 5-in. pipe, through which borings were to be obtained, was then screwed together and washed into the sand to a depth of 40 ft., below the surface of the shoal, and when this was accomplished, a squall from the southwest forced us to discontinue our work. At 4 p. m. the steamer's moorings were unfastened and we returned to our anchorage..

During the night the weather became settled again. On Monday morning, May 28, with a perfect calm, the steamer went under way at 5:30; it was moored alongside the beacon again at 7 a. m., and within three hours the 3½-in. and 2-in. pipes were sunk as contemplated, and the borings to a depth of 105 ft. below the surface of the shoal were secured. The water for washing the piles and pipes was furnished by the steamer's wrecking pump under a pressure of 120 lbs. per sq. in., but this pressure had to be reduced when the 3½-in. and 2-in. pipes were nearly sunk to their required depths, for the friction of the water and sand on the outer surfaces of the pipe was so great that it stopped the descent of the pipes by their own weights. The borings which were brought up in the annular space between the pipes were caught in a canvas bag above the surface of the sea, and consisted mainly of fine alluvial sand. The sand of the surface of the shoal is light in color. The sand from a depth of between 40 and 80 ft. below the surface of the shoal is light gray in color and clean. The sample from a depth of between 80 and 105 ft. below the surface of the shoal is dark gray in color, very fine and mixed with small shells and black mud.

The structure was then cleared of all unnecessary planks and timbers; the moorings of the vessel were taken up, and at 11 a. m. we left for Norfolk, Va., where we arrived at 3 a. m. on May 29, without having had a single accident during our undertaking. It is not only gratifying, but just, for me to state that the efficient services of the Merritt's Wrecking Organization have been a most important factor in the successful result of our work.

THE ACCIDENT TO THE EARTH DAM, ALTOONA, PA., WATER-WORKS.

On May 20, 1894, water flowed over the top of an earth dam connected with the water-works of Altoona, Pa., doing some damage to the lower slope, as described and illustrated in our issue of June 7. In response to a request for further information, Mr. Harvey Linton, City Engineer of Altoona, has sent us the following:

The area of the water-surface at the elevation of the spillway (1,496.5, P. R. R. datum) is 12.62 acres. The storage capacity of the reservoir was estimated at 65,000,000 gallons. Owing to the action of floods it is now probably not more than 60,000,000 gallons.

The area of the watershed was determined by planimeter measurements on the topographical maps of the Second Geological Survey of Pennsylvania, scale 1,600 ft. to 1 in., to be 9.12 sq. miles. Dr. Dudley's rainfall observations do not show the rainfall each hour, I believe, but only for each 24 hours. I will refer your letter to Dr. Dudley for a reply from him. The reservoir was full when the storm began, and for some days previous, and at the time of the flood there were opened two 8-in. and four 4-in. pipes which are attached to the 16 and 12-in. supply mains. Water Superintendent S. A. Galley gave me as his estimate of the flow of the 16-in. pipe 3,000,000 gallons daily into the distributing reservoir in the city, the elevation of which resevvoir is 1,332.6 ft.

Mr. Galley's theory of the cause of the overflow of the embankment is this: In the "Glen White Hollow," a few miles above the storage reservoir, there was at one time a saw mill. The rubbish from this old mill made "three or four jams" in the stream below. These obstructions giving way one after another, or almost simultaneously, allowed a considerable amount of water to flow into the reservoir, in addition to the surface flow. This sudden rise of the water caused the damage, and the time during which the water overflowed the embankment was, in Mr. Galley's opinion, much less than half an hour; probably not more than ten or fifteen minutes.

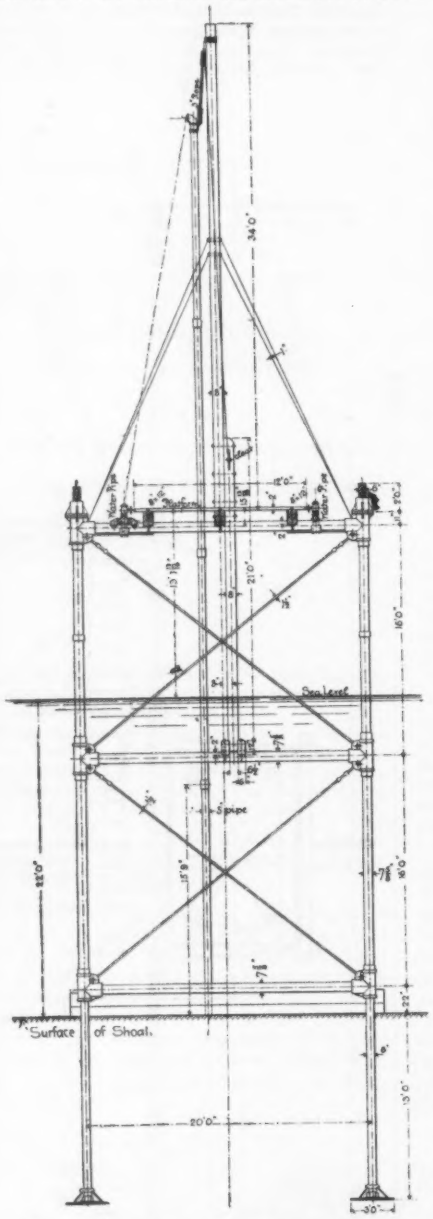


Fig. 2. Structure in Position on the Shoal.

In connection with the work on the new reservoir, I understand that there will be constructed at the north end of the old reservoir embankment a by-pass or floodway. The damage to the embankment is being repaired. The top of the embankment will be made 6 ft., or more, higher than the spillway.

Regarding the rainfall during the week of the flood, the damage having been done on May 20, Dr. Chas. B. Dudley, M. Am. Soc. C. E., Chemist of the Pennsylvania R. R. Co., wrote to Mr. Linton as follows:

The storm began here Wednesday afternoon, May 16, and up to Thursday noon, the rainfall was 0.77 in. Between that and Friday noon it was 0.07 in. Between that and Saturday noon it was 0.60 in. From Saturday noon to 6 o'clock Saturday evening, 1.67 ins. more rain fell. From 6 o'clock Saturday evening until Sunday noon, 1.97 ins. more rain fell, and from Sunday noon to Monday noon, 1.28 ins. more. (The overflow occurred on Sunday.—Ed.) From Monday noon to Tuesday noon, 0.08 in., and from Tuesday noon to Wednesday noon, 0.33 in. more rain fell. This makes a total of 6.77 ins. in seven days. Our rain gage is patterned after the signal service rain gage, and is, we believe, thoroughly reliable.

RAILWAY SIGNALING; THE BLOCK SYSTEM.

By John P. O'Donnell, M. Inst. C. E.*

This paper is an attempt on the part of the author to describe what appears to him to be the generally accepted definition, so far as the experience in Great Britain is concerned, of the four important divisions of railway signaling: First, a description of the block system; Second, a description of the interlocking system; Third, a union of the lock and block systems, which is an amalgamation of the two former, or making one interdependent upon the other; and Fourth, what we understand, although we have had little practical experience of this, of what is an automatic block system. The paper amplifies the accepted usages, so far as Great Britain is concerned, and has more particular reference to the third question, the union of the lock and block. It is an endeavor to point out, firstly, the results that should be obtained from any lock and block system; and, secondly, the little that is actually obtained from the present lock and block system.

The Board of Trade requirements in Great Britain, under which all railways are subject to the inspection and approval of the officers of the British Board of Trade, are given so far as relates to signaling. It may be mentioned that whereas, about the year 1860, 150,000,000 passengers were carried over the railways of Great Britain, and 230 individuals were killed during the year in accidents to trains, in the year 1893 there were carried over 870,000,000 passengers over the railways of Great Britain, with a total casualty list of 17 passengers killed and 484 injured. In relation to the returns of injuries it should be distinctly understood that the smallest accident, if it should in any way reach the Board of Trade, is reported upon and included in the list of injured.

The question is put to railway managers, some of whom consider that their traffic will be hampered by an adoption of the modern form of interlocking and block system, while others, perhaps with good reason, say that the system is too costly for their lines to adopt and the traffic does not warrant it, whether, if their annual accident bill were taken and capitalized, the resulting sum would not, in a large number of cases, go a considerable length in signaling the whole of their lines? Among the points which the author considers may be advantageously discussed, and which points have occurred to him through reading the American Railway Association's proceedings, in view of an apparent diversity of opinion in the association, is the use of the distant signal. There would appear, also, to be a further distinction suggested to be drawn between what is called the "telegraph block system" and the controlled manual and automatic block systems in relation to distant signals. It may be observed that signaling as a whole, no matter what the operating power may be, or what the system may be, or what the convenience of the promoters of the various systems may be, should, under all conditions and systems, be for the best information of the engine-man; that, so far as visual indication to the engine-man is concerned, they should be of one uniform type, and, in relation to the class of signals, one uniform system. It is little in-

* Abstract of a paper presented at the convention of the American Society of Civil Engineers, at Niagara Falls.

formation or concern to an engine-man who has charge of the train as to whether it is an automatic system, or whether it is a manually controlled system, or whether it is an ordinary block system; such matters do not concern him, and in fairness to him, all systems, so far as his eyes guide him, should be the same outwardly.

For any signaling engineer who wishes to assist in reducing signaling to a science, in other words, to reduce it to a standard system, the first point he will wish to settle is the shape of the signal; for, after all, this is all that guides the engine-man in charge of the train. All the leading authorities and practice (and the results of many years' experience) agree upon the use of the semaphore arm as the standard shape.

No good can come to the art of signaling, and certainly none to the traveling public, by hesitation or apologies in enunciating its main principles. It would appear to be a backward step on the part of the leading railway association to make provision and to publicly countenance the use of the "disk" in lieu of the "semaphore," as the signal for guidance on passenger tracks. At all events, the "day signal" for passenger tracks should be, whether it be semaphore or disk, one of position and not of color.

PERSONALS.

Mr. Geo. Hornung, M. Am. Soc. M. E., of Cincinnati, O., has been appointed City Engineer of Bellevue, Ky.

Mr. Elmer L. Corthell, M. Am. Soc. C. E., has had conferred upon him by Brown University the degree of Doctor of Science, in recognition of his engineering work in the United States and Mexico during the past 25 years.

Mr. Robert Darragh, a prominent contractor and builder of New York city, died on June 19 at the age of 69. Mr. Darragh erected a large number of the most important business blocks built in New York city during the last 25 years. He was a member of the Croton Water Board and the inventor of the Darragh water filter.

Prof. T. C. Mendenhall, Director of the United States Coast Survey, is reported by the daily newspapers to have resigned, or to be about to resign his position as a consequence of the movement to abolish the bureau of the U. S. Coast and Geodetic Survey, which is headed by Congressman Enloe, of Tennessee (Eng. News, March 29, 1894). The conflicting rumors make the correctness of these reports doubtful, and Professor Mendenhall refuses to make any statement except to say that he is still at the head of the bureau.

Marie Francois Sadi Carnot, President of France since 1887, was assassinated by an Anarchist at Lyons, France, on June 24. President Carnot was born at Limoges on Aug. 11, 1837, and was educated as an engineer, graduating in 1863. After holding the position of Secretary of the Department of Bridges, he was stationed as engineer at Annecy. During the troublous times of the early '70's he was placed in charge of the military defences on the Lower Seine and on Jan. 10, 1871, he was made Prefect of the Lower Seine. For several years he was a member of the Chamber of Deputies. During 1880 and 1881 he was Minister of Public Works in the cabinet of M. Jules Ferry, and returned to the same post in 1885, leaving it only to become Minister of Finance. M. Carnot's election to the Presidency, in 1887, was owing chiefly to his reputation for unswerving integrity, a reputation which has always been maintained, even during the trying times when the scandals which followed the fiasco at Panama involved so many of the public men of France. The late President was of the same family as the famous scientist, Sadi-Carnot, and was indeed named after his eminent relative. A brother, M. Adolphe Carnot, was also educated an an engineer, and is Sub-Director of the National High School of Mines. The second son of the late President, M. Ernest Carnot, graduated at the School of Mines and is now an inspector in the service of the Messageries Maritimes.

A cablegram of sympathy for Madame Carnot, on behalf of the engineers of America, has been forwarded in care of the Secretary of the French Society of Civil Engineers by Mr. E. L. Corthell, one of the few members of that society resident in this country.

NEW PUBLICATIONS.

IMPROVEMENT OF THE ROAD SYSTEM OF GEORGIA. By O. H. Sheffield, C. E., University of Georgia. U. S. Department of Agriculture, Office of Road Inquiry, Roy Stone, Special Agent and Engineer in Charge. Bulletin No. 3; 8vo; pp. 31; Pub. Doc.

This is a study, presented in popular form, and received a prize in 1892 from the State Agricultural Society of Georgia. There is very little in it of value to engineers, but it was doubtless intended almost, if not quite, wholly for the non-professional reader.

TRADE PUBLICATIONS.

CAST IRON PIPE: Anniston Pipe & Foundry Co., Anniston, Ala. F. B. Hawkins & Co., 29 Broadway, N. Y., 70 Kilby St., Boston, Eastern Agents. 12mo; pp. 16.

This pamphlet contains some useful tables, as well as information, regarding the above company and its products. A special form of hub and socket joint is used, which is claimed to give a better joint than other forms with the use of less lead.

SOCIETY PROCEEDINGS.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—(Concluded from p. 514).—The discussion on the report of the committee on Boiler and Firebox Steel Specifications was opened by Mr. S. M. Vauclain, who stated that he considered this one of the best reports upon this subject that had ever been brought to the attention of the association. With the introductory portion of the report he agreed entirely. The remarks of Dr. Dudley should receive careful consideration from the members of the association. The percentage of phosphorus in firebox steel had been kept down to a very low limit. The idea was to approach as nearly as possible 0.03% in the specification. It had been shown by the committee that fireboxes having as high as 0.07% of phosphorus had given excellent results. The Baldwin Locomotive Works' specification for firebox steel was limited to 0.03% and 0.05% on boiler steel. After reading the report carefully, it seemed that if the specification was reversed to 0.05% for firebox and 0.03% for boiler steel, they might get as good results, and even a little better. The amount of sulphur in boiler steel was limited by Dr. Dudley to 0.05% which was all right. It was a very difficult matter for manufacturers of steel to reduce the sulphur on account of the amount of sulphur contained in the fuel. The report recommended a tensile strength ranging from 55,000 to 65,000 lbs in steel for boiler purposes. They had put firebox steel in locomotives down as low as 45,000 lbs. They had had a specification from one railroad that called for firebox steel between 45,000 and 50,000 lbs., none over 50,000 lbs., and had great difficulty in obtaining material for that specification. Probably not more than one sheet out of ten tested showed a perfectly solid fracture, but there would be a fibrous condition in the test piece which suggested laminations, and by examining the test piece and plate also, it was found that there were minute laminations all through the plate that were due to the bubbles that were in the ingots being rolled out in a longitudinal direction.

In regard to the thickness of sheets, the thin plates were always used in the firebox, and these plates as they come from the rolls would necessarily be harder than a thick plate. The thick plate would retain more heat to the amount of surface and cool less quickly. He did not care to have the steelmakers anneal the plates, but preferred to take them as they came from the rolls and test them accordingly. He had thoroughly examined the specification in every way in regard to the chemical composition of the steel. The sulphur was placed as 0.045%, which was pretty hard on the steelmakers. There seemed to be no reason why the phosphorus should not be put at 0.035% and even a little higher. This report evidently intended that the outside boiler plate should be of the same nature as the firebox. In regard to manganese, it was desirable to keep it down (0.40% was a very fair figure), and to do the hardening with carbon. Better service would be obtained if the plates were hardened with carbon. Sheets as high as 0.065% in manganese and as low as 0.012% in carbon did not give as good results as the plates made from the chemical composition mentioned in the report.

As to the receipt of the steel from the steelmakers before putting it into the boilers, the committee has made a first-class specification for boiler plates and firebox plates, if the minority report is excluded. The minority report perhaps contained the ideas of quite a number of people in the business, but he thought personally it was a mistake. The report as submitted by the majority of the committee should be adopted unanimously. The suggestion of the committee to have the test piece attached to the plate when it arrived at the works was a very proper one, as there was considerable trouble to match pieces sometimes. There was another trouble in the receipt of boiler plate. If a plate ½ in. thick is specified, the plate actually delivered may be ½ in. thick on the edge and 9-16-in. in the center. This was due to the springing of the rolls, and in order to guard against that the proper thing to do was to buy plate from manufacturers who had rolls big enough and heavy enough to roll plates of the size ordered without undue springing in the center. He hoped the majority report would be adopted without any change whatever.

Mr. F. W. Dean stated that it was generally considered that the elastic limit of steel coupled with the elongation and reduction of area was the most important quality for a structural steel, and he was curious to know why no mention was made of it in the specifications. Mr. A. W. Gibbs (Penna.), stated that this point had been considered by the committee who came to the conclusion that as the working strains for which boiler steel was designed were always far below the elastic limit, it was not necessary to include it in the specifications, especially since its accurate determination was a matter of considerable difficulty.

Mr. Geo. Gibbs (Chic., Mil. & St. P.), stated that he had tabulated the worn out fireboxes on his road, according to the makes of the steel and tensile strength. The average mileage was 260,000 miles for firebox sheets, and the tensile strength varied between 50,000 lbs. and 60,000 lbs. No difference was found between steels of 50,000 and 60,000 lbs. strength, in regard to the life of the sheet. The defects were from cracking one way or the other, and the low tensile strength steel appeared to crack as readily as the other. He should favor going nearer to 60,000 lbs. than 50,000 lbs., but whether he should favor going higher, he had not made up his mind. The chemical requirements had been very carefully sifted over, and he did not think they could be improved upon. The committee's limits for elongation of the steel were exceedingly liberal to the manufacturer.

Mr. Wm. Forsyth (C., B. & Q.), stated that he was in favor of the 65,000-lb. limit for fire-box steel, and after listening to the discussion, saw no reason for changing his opinion. The tendency was to think that if a fire box sheet cracked, it was because the steel was high in carbon, but the results of a large number of tests had shown that soft, low strength steel was as liable to crack as hard, high strength steel.

A vote was then taken on the adoption of the specifications submitted by the committee as standard, with a change in the condemning point of sulphur from 0.045% to 0.035%, and the majority report was adopted. The noon hour set aside for the discussion of subjects proposed by the members having arrived, it was announced that the subject of experience with compound locomotives would be taken up.

Mr. S. M. Vauclain (Baldwin Locomotive Works.)—The ratio of compounds to simple engines is holding its own. Our experience since the last convention has led us to make what we think are useful improvements in the detail of our system of compound locomotives. The cavity of the valve, leading from the high pressure to the low pressure cylinder, has been enlarged with very beneficial results. The cylinder cock, has been done away with almost entirely, and we have substituted a plain cock for the low pressure cylinder and an ordinary three-way cock for the introduction of live steam from one end of the high pressure cylinder to the inoperative end of the low cylinder, thereby conducting steam to the low pressure cylinder. The apparatus is easily applied. I think these engines are now hauling the fastest trains that are run in the United States. About six months ago we addressed a circular to the users of compound engines asking them to let us know what the engines were doing in the way of economy and cost of repairs. From those roads having the largest number of compounds we seemed to get better results. We have several compounds running at 200 lbs. steam pressure, and their performance is ahead of those engines running at 180 lbs. Instead of being afraid to carry 180 lbs., I would build boilers to run engines at 200 lbs. steam pressure.

Mr. J. N. Lauder (Old Colony).—I think the past year's experience in this country has plainly brought about a feeling among the railroad men that it is very much of a question whether there is to be a compound engine that will compete in service sucessfully with the simple engine. There have been a great many practical tests during the past year, that have shown varied results. Some show fairly well for the compound; others show that there is no advantage in the compound engine. I have no data to present to the association; it is simply what I have observed. There has got to be saving enough in the fuel to compensate for the expense of the engine originally, and the extra cost of maintenance, which will be something, no matter what the parties may say. Whether we will get enough out of the saving of coal to pay for these extras is, I believe, still to be determined. But my opinion is that a compound locomotive is coming that will give us as good service as we can get from the plain engine, and will save a good round sum in the matter of fuel. The engine will have to be kept in good condition. I do not say any better than our present engines should be; but the little leaks and things we sometimes have will tell less with the simple engines than with the compound.

Mr. W. S. Morris (Ches. & Ohio).—The gentleman has expressed himself as believing that the time will come when we shall have a compound engine that would demonstrate a positive value. I think the time has already come when we have that machine. From the experience that I have had with a compound that we are operating on the Chesapeake & Ohio Ry. I judge this to be so. That engine has been in actual service now for two years. It was made by the Richmond Locomotive Works. I have had a comparison made with

ten single engines on the same division. The mileage for the year 1893, made by the compound was 14% greater than the average mileage of the ten simple engines; the repairs were 80% of the average; the oil and waste consumed was 92% of the average; the fuel consumed was 84% of the average; the total expenses of the engine were 94% of the average, and the cost per mile run, in cents, was 83%. The days in the shop during the year were five as against an average of ten for the simple engines. In speaking of the crew the engineer states that he did not have any difficulty whatever in running the engine in any service in which it has been placed—that refers to general freight service, local and through; and the firemen all seemed to like the machine for the reason that she burned less coal. The shop expense, though the average for the year was a little less than the average for the ten, is about the same. We have had no occasion to shop this engine for any special repairs to the compound part. She was put in the shop for a tire turning after 14 months' work.

Mr. John Medway (Fitchburg).—A comparison between a 21 × 26-in. and 31 × 26-in. compound engine and a 20 × 24-in. simple engine made by us showed at first a saving in fuel by the compound engine, but this saving afterward entirely disappeared. The record was as follows:

	Compound.	Simple.
Steam pressure	180	180
Miles run	12,794	19,366
Miles per ton of coal	25.1	22
Repairs per mile, cts.	2.75	1.26

Mr. A. E. Mitchell (N. Y., L. E. & W.).—We use compound engines with the object of reducing the consumption of water. We have run them in fast freight service. The result shows a saving in coal, no greater repairs, and the engineers prefer them to the simple engines. Two of these engines, with 68-in. wheels, were put in the passenger service, and when first received the consumption of coal was greater than on the simple engine. I took active steps to draft the engines properly, and now they are burning less coal than the simple engines, and give good results. I can fully indorse the Baldwin compound engine as a more economical engine than the simple engine. We now have 15 compound engines on our line, 6 of which are decapods.

The hour given up to the discussion of compound engines having expired the regular order of business was resumed by the reading of the report on Locomotive Fire Kindlers.

The first business taken up at the afternoon session on Tuesday was the reading of the report on Exhaust Nozzles and Steam Passages. This report will be given in a following issue.

The discussion was opened by Mr. Wm. Forsyth, one of the members of the committee, who said that the question of what the real angle of exhaust steam from a locomotive was, had not been determined carefully by any experiment, and in trying to get at it they found a great difference of opinion. It would be a creditable thing for a committee to make careful experiments and determine what this was, because it was of great assistance in designing locomotive stacks. If you have the angle it was an easy thing to get the stack pretty nearly right.

Mr. D. L. Barnes.—Regarding the conclusions, it is noticeable, more than anything else, that this report is quite against the long smokestacks, and decidedly in favor of the short smokestacks. Zerah Colburn, many years ago, found a short smokebox gave more vacuum than a long one. This test corroborates it. In the first conclusion we were not able to lower the exhaust nozzle enough past the lower limit, while we were able to raise it so high that the vacuum was decreased; but with the apparatus we could not get where the vacuum decreased on the lower side. If the nozzle were lowered 8 ins. more, we would get a greater vacuum than is given in the tables.

Mr. J. W. McConnell (U. Pac.).—We are using the diamond stack on the Union Pacific. Our cylinders are constructed on a very liberal plan. On our 18-in. cylinders the exhaust is 8 ins. in diameter. On the 19 and 20-in. cylinders the exhaust is 8½ ins. We have a consolidation engine, with a 7⅜ in. double exhaust nozzle, with a diamond stack. The boiler is 66 ins. in diameter, and is so high that we cannot get a stack to exceed 4½ ft. in length. On our passenger engines, 18 × 26-in. cylinder, our exhaust nozzle is 3½ ins. double nozzle. We are running that up in the mountains, where the air is light, and it is supposed you have to run a smaller nozzle in light air than in a lower altitude. The result of the diamond stack in dollars and cents to our company has been that, in 1890, we hauled 254 loaded freight cars one mile with a ton of fuel, while in 1893 we hauled 260 cars with a ton of fuel; in passenger service, 1890, we hauled 119 passenger cars one mile with a ton of fuel and in 1893, 145 cars; in 1890 we hauled 2,590 tons of freight one mile and 1893, 2,757 tons, with one ton of coal; in 1890 our engines were all equipped with the extension front and straight stack; in 1893 they are all equipped with the diamond stack; in 1890 the expense of handling cars, including expense of motive power and car department, was 3.17 cts. and in 1893, 2.79 cts.; in 1890 the passenger service was five cars to a train, and in 1893 5.96 cars. The freight service has also increased—15.86 cars in a train in 1890; 17.12, in 1893. Tonnage has increased, and we have saved in one year 87,000 lbs. of coal by our diamond stack. Our flues were worn out faster with the extension front end. Our experience has been that it is more economical, and that we get better results from the diamond stack than from the extension front end.

Mr. A. E. Mitchell.—I think the combination of the front end and the stack is what decides the question. I have engines on our road with short front end, extension of 18, 24, 30 and 36 ins. They were originally 36 ins., but we have gradually been cutting them down.

I think we get the best results with the 18-in. extension. On these engines we originally had a tapering stack, 5 ft. long. We have made a series of experiments by putting in various sizes of liners until we have obtained the best results with 13¾ ins. at the throat and 16 ins. at the top, 54 ins. long.

Mr. Miller.—During the year we have changed our stacks to three different patterns. We used the first pattern of stack, such as Mr. Mitchell speaks of; it was at the choke, 14¼ ins., and 21 ins. at the top, and 57 ins. in height. There was trouble about the engine steaming. We had on long extension and afterwards tried the short extension. The result was about the same. We increased the size of the stack where it was choked down, making it almost a straight stack. We changed the length of the front end, and while it did not help the steaming as it should, it did help the heating of steam pipes, and we have had better results from the short extension front in this respect.

Wednesday's Session.

At the opening of the Wednesday morning session the report of the committee on Special Shop Tools was taken up.

Special Shop Tools.

The committee finds that while very few attempts have been made at utilizing electricity by the members as a motor or means of supplying power to special tools, they have nearly all recognized the great advantages derived from compressed air. Many have also taken advantage of hydraulic power and by simple and cheap methods have made plants of very considerable proportions with which much of their work heretofore accomplished at much expense for labor has been greatly cheapened and the length of time required to do certain work reduced over two-thirds. This power is particularly applicable to heavy hoists and for drop pits in handling wheels under engines in round-house repairs, etc.

Much attention has been paid to the working of portable universal drilling and boring machines; they are, in fact, indispensable in the larger shops, and in any shop that handles even a few modern engines a month, they can be made to pay largely. Some members have apparatus made by them, but there are on the markets several excellent portable drilling devices, some operated by power from the shop shafting, in shape of ropes, sheave pulleys, flexible shafts, etc., others driven by steam or compressed air. It is found that new locomotive cylinders can be drilled and reamed on the floor near where they are to be applied, faster and more accurately with a good portable device than with most radial drill presses, and the heavy castings do not have to be moved as often as if under the drill press; all the heavy reaming for repairs, drilling out and renewing stay bolts, tapping stay bolt holes, and many other jobs formerly done by hand. The means of conveying power to these drilling machines can also be utilized for cylinder bores, valve seats, planers, etc., and where ropes and sheaves are used in connection with suitable snatch blocks or "turn abouts" the power can be conveyed to any desired point. The committee recommends their adoption as a labor and time-saving device.

The committee finds that the use of convenient hoists is more general than they had reason to expect, yet they are by no means as well introduced as their merits as labor-saving devices demand. With safe and convenient appliances for hoisting work at lathes, planers, drill presses, etc., a large amount can be saved not only in handling and chucking, but the machines themselves can be kept going more steadily and the risk of accidents to employes greatly lessened. Compressed air is being used by a large number of members for this purpose in connection with pneumatic cylinders of their own construction, which can be gotten up cheaply in any shop. Others, by constructing suitable overhead ways, use differential or safety chain hoists to great advantage and get all the necessary movement for taking work from floor, swinging it into position for chucking and handling, frequently dispensing with a helper or laborer at the machines. Some members have cheap and convenient cranes at their larger machines, constructed in the shops at odd times, to which are attached either pneumatic or chain hoists by which work, heretofore very costly to handle, is easily placed in position. These hoists are also used in erecting shops and in the yards for loading and unloading, and in many larger plants compressed air is used for raising cars, in removing trucks, applying wheels, etc.

The possibilities of a good electric plant in connection with large locomotive and car shops are very great; in addition to its use as motive power for cranes, transfer tables, turn-tables, etc., may be considered the lighting of buildings and yards, welding, brazing, and perhaps other uses suggesting themselves as necessity occurs.

Among special tools the possibilities of well designed heavy turret lathes and heavy universal milling machines and punching machines, designed to meet the requirements of heavy locomotive shop repairs, make them the most important special machine tools to be considered in equipping a shop. The punching machine particularly is not as generally used as it should be in repair shops. With a proper punch and accurate templates, about two-thirds of the rough drilling in car repair, and about all in tender and tank work, and very much bridge, roadway and miscellaneous work now drilled in many shops, can be punched at great saving in time and allow the use of drill presses for needed work that cannot be punched.

The report was discussed by several of the members, nearly all of whom spoke highly of the advantages of pneumatic tools, but very few seemed to have paid much attention to electric power driven tools. In respect to this point Mr. Geo. Gibbs (Chic., Mil. & St. P.) stated that he thought there was some danger of compressed air being too extensively used. It had many advantages, and, on the other hand, it was most expensive where used to any great extent. The ordinary air pump used was similar to the Westinghouse pump, and practically used a cylinder full of steam for a cylinder full of air compressed; in other words, the steam was not used expansively. It was conducted through a complicated system of piping, and the loss by friction was heavy. Moreover, in compressing the air the moisture was condensed, and unless the pipes were carefully protected there was trouble from freezing in cold weather. The efficiency of the transmission as a whole was probably not over 20%. Electricity, on the other hand, had a wider field of application, with an efficiency of 70%. Nearly all large railroad shops had electric lighting plants, and these plants could be run at a small additional expense for attendance all day long, and supply current for special tools, such as transfer tables, hoisting and conveying machines, staybolt cutters, etc. He thought that the electric motor would in many cases be found more economical. The greatest disadvantage was the complication and delicate mechanism of the motor itself. Until lately the depreciation had been very heavy; but this condition is being rapidly overcome, and the motors now had very low depreciation.

The next report taken up was that of the committee appointed to recommend a standard method of Conducting Locomotive Tests. The system of tests was practically the same as that presented by the committee of the Am. Soc. M. E., which was published in our issue of May 19, 1892.

The discussion was opened by Mr. D. L. Barnes, who stated that attention should be called to the statement in the report that:

> The consumption of standard coal is referred to the dynamometer horse-power—that is, the power obtained from the pull on the drawbar; first, because the dynamometer horse-power is a correct average record of the power developed; and, second, it is the useful work done by the engine.

It was easy to see that this was not correct. Take, for example, the grades they had in the Black Hills, Mexico, and other places. Here the engine would pull 12 cars and herself, but on a level road she would pull more cars. A great percentage of the total power was absorbed by the engine itself on the grade. That did not afford a fair basis of comparison. He did not think the efficiency pull, as a standard, was a good one for that reason. It was only applicable where the engines were in the same service and on the same road. It might be used as a basis of comparison under uniform and equal conditions, and that only. In stationary engines we used the term "efficiency," and by that meant the efficiency of the engine, the amount of power that could be turned into mechanical power per pound of coal, and it varied from 3% to 11%. The term used for locomotives should be something like that. Nothing was said in the report about the internal friction of the engine. The internal friction would vary as much as 3% and 4%, according to the kind of oiling. The friction on driving axles would range from ½% to 10%, and the internal friction was largely due to the driving axle journals and crank pins. The other friction was small, where balanced valves are used. If you took the dynamometer work, the uncertainty of the internal friction came in. If you took the indicated horse-power, the internal friction fell out. It is impossible, as is found in shop tests of locomotives, to maintain a uniform lubrication, so that you can compare one test with another, so far as internal friction was concerned.

Mr. G. R. Henderson (N. & W.).—I see no reference to the thermal unit test. I think that is really our best guide to determining the efficiency. We have a grade, say, 20 miles long, and wish to find out accurately the amount of heat that is utilized in ascending that hill. We cannot estimate the amount of coal, because there may be considerable difference in the depth of fire in the firebox at the beginning and end of run; but by means of the thermal unit test, working on the quantity of water and pressure, we can get the amount of heat utilized. The report says: "The quantities of steam used by the various auxiliaries of the locomotive can be determined by noting the change in weight of the engine standing upon scales while they are each in use under the usual conditions for known times. Similarly leakage of water and steam can be determined. The quantities can then be deducted from the total water used." It seems to me that this is a crude way of getting at it. It is not an easy matter to adjust the scales so that you can find a small leak of 20 lbs. or 30 lbs. The least you can hope for is to weigh 100 lbs. or 200 lbs. The better way would be to catch the amount of leakage in some vessel of known capacity, and thereby determine the loss.

Mr. F. W. Dean.—Our object in suggesting the weighing was that many of the leaks are steam leaks, and, of course, they cannot be caught in a pail or vessel. It seemed as if weighing was more convenient than anything else. The scale, if in good order, should be really sensitive to 5 lbs.

The discussion was followed by a short recess, after which the report of the committee on Tire Treatment was read. There was no discussion of this report, which was made up largely of the various answers sent in to the committee's circular of inquiry.

Tire Treatment.

The present practice was to use a shrinkage of either 1-80 or 1-100 in. per foot diameter for locomotive driver tires above 56 ins. in diameter. About 66% of the members did not think any increased shrinkage necessary on account of driver brakes.

Concerning the thickness that tires should be considered safe at last turning, the committee finds the recommendations vary from 1¼ to 1⅝ ins. for passenger service; from 1¼ to 1⅝ ins. for freight service, and from 1 in. to 1⅝ ins. for switching service. After a careful consideration the committee recommends that the limit on passenger tires be placed at 1½ ins. for last turning, and on freight and switching tires at 1¼ ins. The weight on drivers should not be considered, and no distinction made between engines equipped with driver brake and those that are not. The wear on tires should not exceed ¼ in. in depth before turning on road engines, and ⅜ in. in depth for switch engines.

The noon hour having arrived the discussion on compound locomotives, which had been in progress at the Tuesday's session, was continued. This discussion brought out considerable additional evidence in favor of the compound locomotive and very little evidence against it. Perhaps the most interesting testimony was given by Mr. Wm. Forsyth (C., B. & Q.), who stated that his experience with compound locomotives was limited to few engines, but extended over a long period of time. His conclusions in general were that the repairs of a compound engine, when properly constructed, should not be greater than those of a simple engine, and the economy in coal should be a clear saving. The principal trouble he had was with the piston breaking in the cylinder. He thought that this trouble had been general with most large cylinders. It was difficult to get a snap ring of good iron and proper proportion, which would retain its spring and hold the packing tight. It sometimes broke and sometimes cut the cylinder. Another objection was the difficulty of handling, which was the fault of the starting gear. The engineer in running onto turn-tables finds he cannot handle it as readily as the simple engine. His company was pleased with the Richmond compound on steep grades. It had the advantage that it allowed you to turn the engine into a simple engine and overcome the objection to the Lindner gear, by using live steam in the low pressure cylinder, when hauling heavy trains on grades.

The discussion was followed by the report of the committee on the Cost of Maintaining Locomotives.

Cost of Maintaining Locomotives.

The special feature which the committee was appointed to investigate was the comparative cost of maintaining locomotives built in contract shops and those built in railway shops. Only a few definite figures were received from the members, but the general opinion seemed to be that the contract built engines were the most costly to maintain. This was borne out by the information received from companies which had kept records of this character. Figures furnished by Mr. J. N. Barr, of the Chicago, Milwaukee & St. Paul Ry., showed that cost of repairs of eight contract engines and six home built engines during a period of 15 months were 2,028 cts. and 1.155 cts., respectively, per mile run. Similar figures were furnished by Mr. G. W. Rhodes, of the Chicago, Burlington & Quincy R. R. The cost of repairs to 18 mogal engines, nine built by contract and nine built at the railway shops, were 5.26 cts. per mile for the company's engines and 5.47 cts. for the contract engines. From these figures and the general tenor of the replies received to its inquiry the committee is of the opinion that on the average the workmanship in railway shops is better than in contract shops, and that, consequently, the repairs of railroad built engines are less for the first few years of their existence than the repairs of those turned out of contract shops, even when the latter are built under thorough inspection.

There was no discussion of the report and the reading of the committee reports being finished the convention proceeded to the election of officers, for the ensuing year. The following were elected: President, Wm. Garstang; First Vice-President, R. C. Blackall; Second Vice-President, R. H. Soule; Secretary, Angus Sinclair; Treasurer, O. Stewart.

The report of the committee on subjects was then received and the convention adjourned. The following eleven subjects were submitted for investigation by committees and to be reported upon at the next annual convention:

1. Stacks, Smokeboxes and Exhaust Nozzles. 2. Locomotive Fire Kindlers. 3. Shop Tests of Locomotives. 4. A Decimal System of Gages for Thickness of Sheet Metal, Tubes and Wire—the committee to confer with manufacturers and others, and to submit a practicable system for adoption by the association. 5. The Utilization of Railway Scrap Material, and best method of handling the same. 6. Causes of Bulging in Firebox Sheets. 7. Best Materials for Boiler Tubes and Specifications for the same. 8. Piston and Piston Rod Fastening, with special reference to pistons of large diameter and light weight. 9. Proportions for Riveted Joints Representing Approved Practice. 10. Wear of Driving Wheel Tires as Affected by Weight upon Them. 11. Pneumatic and Electric Transmission of Power in Railway Shops.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The annual meeting was held at the Cataract House, Niagara Falls, N. Y., June 20 to 25, with an unusually large attendance, the number being about 350 in all. A special train with about 250 members and guests, including a number of ladies, left New York at 8:30 a. m., June 19, the train being provided by the courtesy of Mr. Theodore Voorhees, M. Am. Soc. C. E., and Mr. Rollin H. Wilbur, General Superintendent of the Lehigh Valley R. R. It was made up of a smoking car, seven Pullman cars and a baggage car, and was run as a double header over the mountain division. The trip was a delightful one, and although the temperature was decidedly warm the breeze and occasional cooling showers kept it from being oppressive. After the climb up the Alleghenies from Mauch Chunk, a stop of 45 minutes was made at Glen Summit for dinner, and the train then followed the steep and winding track descending the western slope into the Wyoming valley, the city of Wilkes Barre being plainly visible below. For freight traffic there is a separate line known as the mountain cut-off. The same enginemen run continually on this division and become very expert in handling the trains, so as to maintain a uniform speed. The track is good, and is well maintained, with heavy rails spliced by six-bolt angle bars with nuts and Excelsior nut locks on the inside of the rail. The rails have the ends cut at an angle of about 45°, but the clicking is about the same (as would naturally be the case) as with square end rails with similar splice-bars, showing that it is not the gap between the rails which causes the shock, as has often been pointed out. The ballast is largely of cinders, but is not very dusty. From Van Etten the route was over the new line of the Lehigh Valley R. R. to Buffalo and Niagara Falls, described in our issue of June 21. Supper was served from the buffets in the cars, and the train reached Niagara Falls at about 11 p. m., where omnibuses took the party to their quarters at the Cataract House and the International House, which are only separated by a side street.

The first meeting began pretty promptly on Wednesday morning, June 20, with the President, Col. W. P. Craighill, in the chair, and no fewer than six past presidents on the platform (Messrs. Geo. S. Greene, Wm. Worthen, Don J. Whittemore, Horace Keefer, Wm. Metcalf and Mendes Cohen), while there was a large and representative attendance.

The first paper was on "The Quality of Water Supplies," by Mr. John W. Hill, of Cincinnati, discussing the questions of water pollution, diseases resulting therefrom, methods of prevention, and other matters relating to water supply from a sanitary point of view. Mr. Desmond FitzGerald opened the discussion, stating that while a few years ago the principal matter considered and investigated in connection with water supply was the quantity of water, it is now considered still more important to investigate the quality of the water and to take steps to secure, as far as possible, immunity from disease communicated by impure water. Aeration cannot be taken as applicable in every case for the purification of water, but must be studied in connection with each particular source of supply. It is well to provide greater storage capacity than would be merely sufficient to carry a city through a period of drought, so as to allow some time for the purification of water by settlement and exposure, instead of going directly to the supply system in time of emergency. Mr. Worthen stated that at Southampton, N. Y., he is going to aerate the water in tanks with 100 lbs. air pressure above the water, but cannot tell the results until the water is in use, or, in other words, until he has practiced on the people. He does not believe much in the details of water analysis and bacteriology, except as something to fall back on, and as bacteria are much less dangerous to healthy people, he considers it well to look to the general health as well as to the water supply.

The next paper was on "The Sewage Disposal Works of Chautauqua, N. Y.," by Mr. W. B. Landreth, a plant which was fully described in our issue of Sept. 21, 1893. There was no discussion. Mr. Geo. L. Wilson then read a paper on "The Sandrock Sewers of St. Paul, Minn.," describing the tunnels for sewers, water supply and telephone subways built in the soft St. Peter sandstone (or sandrock). An abstract is given in another column. He stated in answer to questions that ventilation is provided by ventilating manhole covers, 24 ins. diameter, placed 300 to 600 ft. apart, and pierced with 60 holes ¾-in. diameter. Mr. J. T. Fanning said that similar works at Minneapolis, discharging below the Falls of St. Anthony, have a strong through draft which provides ventilation. Tail race tunnels were excavated for saw mill turbines, the tunnels being lined with timber to prevent the erosion of this very soft stone. Mr. Whittemore pointed out that the rock abrades very rapidly, as at the above Falls, and that it will probably be necessary in the future to line the entire tunnel instead of the invert only, and Mr. Wilson said that this had been provided for in the design.

The paper by Mr. John R. Freeman on "Hoisting Apparatus of the Canal Headgates at Sewell's Falls, N. H.," brought out considerable discussion, which commenced with sluice gates and gearing and wound up with the formation and peculiarities of anchor ice. Mr. Herschel did not think it well to carry sluice gates of a water power canal on rollers, although the arrangement answers well for navigation canals, such as the Manchester canal, where Stoney's gates are used. He thought it better to have the gate fitting flat on a flat sill than to have a miter sill, and did not approve of so much elaboration to provide for hoisting by man power when there is water power continually available. He had built a gate 14 × 7 ft., with no water on the down-stream fall, which could be raised (very slowly) by one man with one hand. Mr. FitzGerald said he had built gates 4 × 5 ft. several years ago at the Chesterfield reservoir, Boston water-works, making them almost absolutely watertight by brass sliding on brass, and he thought that insufficient power had been provided at the Sewell's Falls works. Mr. Fanning described gates 6 × 10 ft., with sills 16 ft. below crest of dam, built by him ten years ago, and running on eight sheaves at each side, the sheaves being set into the fall of the gate. Inclined falls on the gate and the jamb made a watertight joint when the gate was thoroughly closed. Mr. Worthen described an arrangement used by him like a huge hollow bath plug, 8 ft. diameter, being an 8-ft. pipe fitting vertically onto the beveled edge of the opening and raised and lowered by chains passing over a differential pulley; this was operated under a head of 25 ft. Mr. Keefer said that a similar plan but with square holes and inverted pyramid-shaped valves built up of oak was designed for the Welland canal locks when it was originally proposed to build the locks of stone instead of timber. Mr. O'Rourke, in discussing the relation of anchor ice to the operation of valves and gates, stated that in putting in the pile foundations for the Wisconsin River bridge during the winter, with the river entirely frozen over, but flowing rapidly under the ice, it was found on cutting off the piles below water that they were thickly coated with ice, which he attributed to the coldness of the piles. Mr. Keefer said that anchor ice consists of the needles of crystallization, kept apart by the motion of the water by wind or current, and these form slush ice, which, in the St. Lawrence, will flow under the surface ice, adhering to it and growing downward so as to form a suspended dam. The ice will also adhere to the bottom of the river to a depth of 2 ft., rising if broken off by a pole or otherwise. The session then adjourned.

At the afternoon meeting a large number of papers were disposed of, there being little discussion, as a rule, although no attempt was made to rush through the program or check discussion. Abstracts were first read of two papers on similar subjects: "Notes on Wire Rope Tramways," by A. C. Savage, and "Steam and Electric Cableways for Logging and Canalboat Towing," by Richard Lamb. Mr. Lamb's paper described methods of hauling logs from the place where cut to a cableway

which transports them to the mill. The advantage of the electric system devised by him and in use in swampy districts, is that he can get the power at whatever point he wants it. Mr. Miller did not think it correct to say that the Butter's one-span steam cableway is being abandoned, and he knows its use to be extending, particularly in the South. The system is operated in a circle, one end of the cable being shifted and forming the radius. The pull-boat system has a limit of about 3,000 ft. in length. He thought Mr. Lamb's apparatus capable of wide application. The paper on "The Cippoletti Trapezoidal Weir" was not discussed. This weir is designed to simplify the hydraulic formula used, and has the sides sloping outward 1 to 4, forming a trapezoidal instead of a rectangular section. A paper entitled "A Few Remarks about the Niagara Gorge" was then read by Mr. L. L. Buck, in which he estimated 4,000 years as the time required to cut back to the present position of the falls, by erosion of the softer strata and breaking off of the harder top strata. Mr. Garrison thought this old figure of 4,000 years should not be accepted, as to obtain it we must assume the climatic conditions to be uniform for 4,000 years, which is assuming a good deal. According to Sir Charles Lyell's opinion the gorge was due to a fault in the geological formation, and traces had been found of a river course through which the water ran before it ran through the gorge. The Grand River falls in Labrador have a gorge 20 miles long in very hard rock. Another member pointed out that Sir Charles Lyell had estimated the time for cutting the gorge at 100,000 years, while later geologists have reduced this estimate to 10,000 years and less. Mr. Fanning said that the Falls of St. Anthony, on the Mississippi, in the soft sandrock receded 100 ft. per year, until protected by a timber apron.

A brief but very interesting paper on "The Form of Railway Excavations and Embankments," was then presented by Mr. D. J. Whittemore, in which he advocated rounding off the top and bottom corners of cuts and fills, paving the ditches and sodding the slopes. We believe the Southern Pacific Ry. follows out the practice of rounding off the top corners of its fills. As Mr. Whittemore pointed out, this is the material which has to be continually removed by the ditching train, and is thus charged to maintenance, while the extra cost in first construction would be saved in one year's maintenance. This matter ought to be properly put before the directors by the engineers. Mr. Cohen thought that in this country it would be practically impossible for many roads to go to the expense of sodding in first construction. Mr. Crowell considered that ditches are often built along the top edges of cuts when not necessary, and are often too deep, keeping the material of the cut wet. As to the expense, while it is true that many roads have not the money in hand to do sodding and slope paving in first construction, that does not affect the question of proper practices. Mr. Fitzgerald referred to the common requirement of 9 ins. of loam for seeding or sodding, but he considers 24 ins. necessary. Mr. Reed referred to the practice of the Lake Shore & Michigan Southern Ry., in regard to slopes, while cutting down its grades. Abstracts of the papers on "Brafford's Ridge Tunnel," by C. W. Staniford; "Tequixquiac Tunnel, Valley of Mexico," by A. J. Campbell and T. A. Abbot, and "Friction Rollers," by C. L. Crandall and A. Marston, were then read, without discussion, and the session adjourned.

At the evening session the annual address was read by the president, Col. W. P. Craighill, the subject chosen being our coast defenses. He pointed out that however heavily ships can be armored, land forts can always be still more heavily armored, while guns of the same size can be more cheaply mounted and more readily used in a land battery than on a floating battery. In warships themselves the gun always has the advantage over the armor, and the shipbuilders can only attain a certain degree of protection by armor relative to the carrying capacity of the vessel. In fact, he thought it possible that in the future the ship armor may be very considerably lightened and more and heavier guns mounted, approaching to Admiral Farragut's idea of "broadsides rather than ironsides." We must not rely entirely upon our navy and the militia, but must provide coast defense works. He referred to the importance of inland waterways, such as the Atlantic coast line canal, a Lake and Mississippi canal and an enlarged Erie canal, and be also strongly urged the strategic as well as commercial importance of the Nicaragua canal, and the importance of having it under the control of the United States, which proposition was received with loud applause. The address was followed by a general statement by Dr. Coleman Sellers, dealing with the history and development of the great Niagara Falls water power system now being completed, for utilizing the immense power of the falls, and this was followed by a more detailed description of the works, the machinery and the plant generally, by Mr. W. A. Brackenridge and Mr. Sellers. The work has been fully described in our columns.

On Thursday, June 21, the morning session was called to order with commendable promptitude, and the first paper presented was on "The Pulp Mill of the Cliff Paper Co., at Niagara Falls," by Mr. W. C. Johnson, and was listened to with considerable interest. In the discussion Mr. Herschel stated that the paper showed the tendency of engineers to carry out investigations and to carry the results of their figures into practice. He did not know of any other case where, as at this mill, the specifications required the machinery to turn out a certain amount of product per cubic foot of water used, and in this case the machinery had in practice more than fulfilled the requirements of the specifications. Mr. Fanning referred to tests made of the water used and the product turned out at flour mills and sawmills at Minneapolis.

A brief abstract of a very excellent paper on "Railway Signaling and the Block System," was then read by Mr. J. P. O'Donnell, dealing with the history and development of fixed signals and block working, and also with modern practice in this direction. In referring to the lock-and-block system, he said that the New York Central R. R. stands ahead of any other railway in the world in the extent and completness of its equipment with the well-known Sykes lock-and-block system. This statement, coming from an English engineer of such extensive experience in signaling and railway work, naturally caused some surprise as well as pleasure to the audience. An abstract is given in another column. The discussion was opened by Mr. Crowell, who referred to the Kinsman system by which the brakes are automatically applied in the event of an engineman running past a signal at "danger," but Mr. O'Donnell pointed out that this would practically necessitate abandoning distant signals, as such signals are allowably passed at danger, while Mr. Wallace, of the Illinois Central R. R., pointed out that while the cost of equipment to each engine might be small, yet it would be considerable when applied to all the engines of the road, which would be necessary, as any one engine may be run over any part of the road in an emergency or in going to the shops, etc., while the engines of foreign roads running over the road would also have to be similarly equipped. Mr. Prout referred to the use of automatic signals having the normal position at track blocked, and Mr. Wallace stated that in regard to automatic signals so arranged there would be a serious interference with traffic, if used for high speed service. The Hall automatic signals on the Illinois Central R. R. have the normal position at track clear, but will go to track blocked in the event of a switch being left open, a rail breaking or a battery failing. The track circuit is used and a traffic of 19,500,000 passengers was handled at the time of the Columbian Exposition with no failure of the signal by which track clear was shown when track blocked should have been shown. He considered the system quite satisfactory, but a member raised the objection of ice or wet snow sticking to the glass so that the color cannot be seen while there is no position to give the engineman any indication. Mr. Wallace said that the Hall signal had been adopted for economic reasons, as being less costly in maintenance than the automatic electro-pneumatic system with semaphores, and the disk signal has the advantage in this case of being (by day) easily distinguishable from the absolute block manual signals used at junctions and crossings. Mr. Tratman referred to the Black mechanical automatic system used on the Manhattan Ry., and to the Mozier train dispatcher block system in which the communication is not from block to block (as A to B, B to C, etc.), but from the dispatcher's office to each block (as A to B, A to C, etc.). He considered devices for automatically stopping trains at block signals as about on a par with devices for operating switches from the engine. He also called attention to the English practice of allowing a switchman at a station to send to the preceding signalman the message, "section clear but station blocked," indicating that there is a train in the station, thus introducing a permissive element, which has led to numerous accidents, and Mr. O'Donnell explained that the Board of Trade is endeavoring to secure the abolition of this practice. The discussion was then closed, to be resumed on Saturday.

The meeting then proceeded to carry out the exceedingly clumsy arrangement of selecting members for the nominating committee, as required by the constitution, and although the president called attention to the actual importance of the matter, the prevailing idea seemed to be to regard it in the light of a more or less humorous performance.

In the afternoon the party crossed to the Canadian side of the river and took special cars on the electric line of the Niagara Falls Park & River Ry. Co., going first to the power house, and then along the bank of the river to Queenstown, where the line descends by steep grades and sharp curves to the steamboat pier. This line is 14 miles long, and will eventually be 34 miles long. It is double track, standard gage, and laid out with a view to showing the scenery. The bridges are of steel on masonry abutments. The ruling radius of curves is 100 ft., and the maximum grades are 5.7%, while the descent to the wharf at Queenstown is 330 ft. in 7,250 ft., or 4.4%. The track is of 56-lb. steel T-rails, with four bolt angle bar joints and ties spaced 24 ins. c. to c. in stone ballast. Curves and exposed sections are protected by inside iron guard rails and outside wooden guard rails faced with angle iron. The hydraulic plant is designed of 3,000 HP., but at present only 2,000 HP. is developed, being produced by two American turbines working under a head of 57 ft. The electric plant at the main power house at the falls has three Thomson-Houston multipolar dynamos of 200 K.-W. each, while at Queenstown there is a subsidiary plant of 268 K.-W., run by steam power to supply current for the steep grade terminal, which is a more economical course than the transmitting of the large excess volumes for an hour or two daily from the main power house 9½ miles distant. The line is wired for 31 motor cars of 15 tons each, the feed and trolley wires being carried in wooden poles, except within the park where steel poles are used, each surmounted by a cluster of five incandescent lights. Some of the cars have cross seats, while others have two longitudinal seats, one rather higher than the other, and both facing the river. The line was located and built under the direction of Mr. W. T. Jennings, M. Am. Soc. C. E., Chief Engineer.

From Queenstown some of the party returned by the electric railway, while others crossed the river to Lewiston on the Toronto steamer "Chippewa" and took the observation cars of the New York Central R. R., on the east side of the river, getting an excellent view of the wild scenery of the gorge below the whirlpool. In the evening there was dancing at the International Hotel, and the park gates were left open to enable visitors to view the rapids by moonlight.

On Friday, June 22, a large party took special electric cars on the Niagara Falls & Suspension Bridge Ry., proceeding to the power house of the Niagara Falls Power Co., and examining the power house, canal, wheel pit, etc., all of which have been recently described and illustrated in our columns. Thence a special train took the members for a trip over the Niagara Junction Ry., an incident of which was an excellent view of a race between two passenger trains on the parallel tracks of the New York Central R. R. and Grand Trunk Ry. After an inspection of the dock or pier, and the buildings being erected for the Pittsburg Reduction Co.'s plant, the party proceeded to Echota, the model town laid out for the industrial population which the manufactories will call together. After an elaborate lunch in the public store and assembly room, the party visited the cottages (designed by McKim, Mead & White, of New York), and the sewage purification works, the sewage being treated by the chemical precipitation process. The land is drained and the water collected in a well and pumped to the river. The sewerage system leads to the disposal works, and the sludge is used on the land. The streets have telford-macadam paving, and have sidewalks, turfed spaces and shade trees.

The party then returned to the train and proceeded to the works of the Niagara Falls Paper Co. (recently described in our columns), which are driven by turbines in the same way as the Power company's plant, with a tunnel discharging into that of the latter company. There are now in service three 58-in. Geyelin-Jonval turbines running 260 revolutions under a head of 144 ft., and each transmitting 1,100 HP., while the plant can be increased to a capacity of 7,000 HP. The mill buildings are quite extensive, and are equipped with machinery of the latest designs, including ten pulp grinders of 275 HP. each, and paper machines of the cylinder and Foudrinier type, one of the latter making paper 136 inches wide. The paper machines are said to be the largest in the world, having a capacity of 60 tons of finished paper per day, but we are informed that the mills at Rumford Falls, Me., have an equal capacity of product. From this place the party returned by the electric railway to Niagara Falls, after an interesting and instructive excursion.

On Saturday, June 23, a business meeting was held in the morning, Mr. Macdonald, Vice-President, in the chair. A ballot on members for the nominating committee was taken, and resulted as follows, according to the usual geographical divisions: 1, Clemens Herschel; 2, E. Kuichling; 3, J. R. Freeman; 4, C. M. Bolton; 5, V. G. Bogue; 6, J. W. Kendrick; 7, T. M. R. Talcott. The amendments to the constitution were then taken up, and several were referred to a committee to be appointed by the president and to report at the annual meeting in January, with power also to suggest further amendments. All the proposed amendments relating to striking out the grade of Subscribers will go to letter ballot, and it was pointed out that there are now no members of this grade, which was originally provided for when it was thought that other societies would affiliate with the main society. In regard to the references given by applicants for membership, the change is to prevent the trouble formerly experienced from applicants giving the names of persons who on inquiry were found to know but little of the applicant, or to be even opposed to his election. There was

some discussion as to the publishing of the names of referees on the blue list or ballot, but it was finally decided that they should appear on one or other. This matter will go to the committee. The disputed point as to the secretaryship was discussed at some length, it being generally agreed that he should be elected by the Board of Direction and not by the society at large; but there was a difference of opinion as to whether or not he should be required to be a corporate member. Inasmuch as he has to represent the society as its general executive officer at headquarters, besides attending to business matters, and as the business and clerical work should largely be attended to by the assistant secretary, it was considered advisable that the secretary should be a corporate member. It was voted that this matter should be sent out at once for ballot, so that the vote may govern the next secretaryship, but it is doubtful if the rules of procedure will admit of this. In any case he should be appointed by a majority of the Board of Direction, and not by a majority of a quorum of that board. As to the amendment in regard to nominations for officers it was objected to the proposed plan that it would make the Board of Direction too much of a self-perpetuating body, and Mr. George S. Morison proposed a plan based upon that by which the alumni association of Harvard College elect the overseers of the college. There would be a committee on suggestions which would send out a list of members proposed for election, accompanied by a blank ballot, on which each member would fill out one name for each office. By this plan the membership at large would have a voice in the selection of officers, and while the matter was referred generally to the committee it was voted that the meeting expressed its approval of the general principles of the plan proposed by Mr. Morison.

Votes of thanks were then passed to the Cataract Construction Co. and allied companies, to the general and local committees of arrangements, to the electric railway companies, to Mr. Voorhees for his assistance in connection with the special trains, and also to the officials of the Lehigh Valley Ry., New York Central Ry., Grand Trunk Ry., and the Niagara Navigation Co. for special courtesies in transportation. The business meeting of the convention then finally adjourned. In regard to the arrangements special credit is due to the local committee, and its chairman, Mr. W. A. Brackenridge, for the very complete arrangements and the thorough way in which they were carried out and the comfort and pleasure of the visitors attended to.

In the afternoon the last meeting for the presentation of papers was held. Professor Langley presented a brief report of progress from the sub-committee of the committee on uniform tests of material, describing the preliminary steps thus far taken. Mr. Fitzgerald, for the committee on badges, stated that a number of designs had been prepared, but it had been decided best to leave all emblematic designs off, and to use only the words "American Society of Civil Engineers, Founded 1852." The badge would be of the present form but slightly longer, and of blue enamel and gold as at present, so that it would be easily recognized by those familiar with the present badge. The discussion on "Railway Signaling" was then continued, Mr. Crowell describing the Kinsman automatic system (as experimentally in use on the Chicago, Milwaukee & St. Paul Ry.), which he claimed could be used with or without visual signals, and he made light of the trouble of equipping engines, comparing this to the trouble of car couplers. This, however, was not a fair comparison, as couplers can be changed in a few minutes, while it is not possible to apply the Kinsman appliances to a strange engine from another division or from a foreign road. Mr. O'Donnell briefly alluded to the difficulties which would necessarily arise in switching operations and thought that if used at all it might be as an adjunct to the ordinary signal system. Abstracts were then read of the papers on "The Load Line in Telephone Exchanges," by A. V. Abbott, and "Removal of Rock to a Depth of 40 Feet Below Mean Low Water," by John A. Bensel. In discussing the latter paper, Mr. R. A. Cummings referred to the Lobnitz rock-cutting machine or dredge, one of which has now been built for government service at Troy. He also referred to the dipper dredge designed to work to 46 ft. of water in Montreal Harbor, but Mr. Geo. S. Greene, Jr. ,did not think this latter had been worked at a greater depth than 27 ft. Mr. Garrison presented an abstract of his paper on "Testing Building Stones," describing shearing tests of rectangular instead of cubical blocks. He did not think lead bearing plates were satisfactory in testing but admitted that he had not tried them. A paper on "Tests of Condensation in Cast Iron Radiators" was read by Mr. W. J. Baldwin, and a paper on "The Marking of Street Lines," by Mr. C. M. Broomall, was then read by title. Mr. T. Guilford Smith described in a few words the plan of establishing traveling libraries as carried out under authority of the state of New York, and referred to the advantages thus within the reach of an engineer stationed away from the centers of civilization. The meeting then adjourned.

In the evening there was a reception, which was very largely attended, and which was followed by dancing and supper, the whole affair being exceedingly well managed and very enjoyable.

On Monday, June 26, a party of about 270 members and guests left Niagara Falls for Lewiston, by special train on the New York Central R. R., and taking the Niagara Navigation Co.'s steamer "Chippewa," they were landed in Toronto at about 1 p. m. The party proceeded directly to the Queen's Hotel, where they were entertained at a luncheon, as the guests of the city. An address of welcome was delivered by the Mayor, and was responded to by Mr. Charles Macdonald, Vice-President of the society. After lunch, four trains of electric cars (each accompanied by two of the city's military-looking policemen) and the directors, private car of the Toronto City Electric Railway Co. conveyed the party about the city and suburbs. The cars eventually landed the visitors at "The Hall," the residence of Sir Casimir Gzowski, Director, Am. Soc. C. E., where they enjoyed the social pleasures of a garden party, after which they were taken by the electric cars to the station. Here a special train of the Grand Trunk Ry. was in waiting to carry them back to Niagara Falls, which point was reached at about 10 p. m. On the following morning the special train for New York and Philadelphia, over the Lehigh Valley R. R., was in readiness at the station, and by it the most of the members journeyed homeward. Thus ended one of the pleasantest and most largely attended conventions in the society's history.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on June 16 Mr. W. C. Furber gave a very fully illustrated description of "The Engineering Features of the Harrison Building," illustrating his remarks with large drawings of the building, and details of its construction and ornamentation. In erecting the building, the entire framework of iron was first put in place, and the walls of each story were built on the frame independent of the walls below.

Mr. Benj. Franklin read a discussion of Mr. Schermerhorn's paper "On the Improvement of the Delaware River at Philadelphia," which was presented at the meeting of May 19, prefacing his remarks by explaining that the discussion had been prepared jointly by Prof. L. M. Haupt and himself.

The improvement of the channel in front of the harbor will cost the government about $3,500,000 for excavation, and the city about $8,000,000 more for advancing the piers to the new lines established by the Secretary of War.

Mr. Schermerhorn's conclusion that the Delaware River is not a silt-bearing stream, and that, consequently, properly located artificial channels would remain of permanent depth, appears to be erroneous, because, in the first place, the section, as proposed to be built, is not the normal one of 55,000 sq. ft.; secondly, because the dredged channels, which have been so often reopened, do not maintain themselves as a matter of fact; and, third, because the visible appearance of the water gives every indication of its being charged with silt.

It is not the small ratio of fluvial to tidal water that determines whether a river is silt-bearing, so much as the character of its bed or the geological formation through which it flows, and as the Delaware's bed is alluvial and readily abraded by the ordinary currents, it is evident that permanency of result can best be obtained by regulating works, and no dependence can be placed upon dredging without such auxiliary structures.

At the conclusion of Mr. Franklin's remarks Prof. L. M. Haupt stated that in view of the great expense involved it was important that the plan be thoroughly digested, and showed by diagrams and figures that the total normal cross-section, as designed by the Board of United States Engineers of 1888, would be located between the pier head lines, and that the modified proposition to build open piers would, in consequence, largely increase the sectional area and reduce the velocity of the currents, whereby their ability to scour would be diminished at least 40%. The compensation for this enlarged section would take place in the navigable stream to the eastward of the center and would amount to a shoal of not less than 10 ft. in height by about 800 ft. in width of section, thus reducing the required navigable depth at mean low water from 26 to about 16 ft., and rendering constant dredging necessary.

As it was suggested that the vessels in the docks would act as a substitute for solid piers, Professor Haupt objected that the currents would scour out deep pockets under them, and this material would be dropped in adjacent docks or in the stream itself, making the bottom humpy and requiring additional dredging. It was thought to be unwise to expect the vessels to do the work of a permanent structure.

L. F. Rondinella, Secy.

ENGINEERING ASSOCIATION OF THE SOUTH.—At the meeting on June 14, the resignation of Prof. Olin H. Landreth, who has accepted the Chair of Civil Engineering at Union College, Schenectady, N. Y., was presented, and in accepting the same the following resolution was adopted:

"Resolved, That in accepting the resignation of Prof. Olin H. Landreth, the association appreciates the fact that it loses a member to whom it is indebted for the initial labor which was essential to its creation and for efficient services as secretary and member. We feel confident that the same energy and discernment which he has displayed in the discharge of his duties to this association and this community will insure success in his new field. We wish him well."

It was decided to adjourn after this meeting until the regular meeting in September next. The paper of the evening entitled, "A Sketch of a Modern Blast Furnace Stack," by Mr. A. Porter Gaines, superintendent of the Cowan Division of the Tennessee Coal, Iron and R. R. Co., was read by the Secretary. The universal construction of a modern stack is a round sheet iron shell somewhat in the form of a truncated cone, supported at the base, which is the widest part, by columns. This shell is lined with fire-brick, having a packing space of 3 to 5 inches between the shell and the brick, which is filled with some light loamy material. The points of difference are the dimensions of this shell, the height, diameter, distance from hearth or bottom at which shell shall be supported and interior shape or lines as given by fire-brick lining. The conditions governing the dimensions are chiefly the character of the stock (fuel, ore and flux), and the volume of the blast. Modern practice is towards large outputs and the dimensions are as large as these conditions will admit. The interior shape is more or less in dispute among furnace men. It is largely theory as to the mechanical arrangement and chemical changes that material undergoes in the stack, so necessarily it follows that there would be more or less difference as to the interior arrangement of furnace to obtain the best results. The conditions are so different in different localities, that it is questionable whether there will ever be any specific lines found that will give universal success. Although there have been wonderful results obtained from the modern blast furnace stack, both in fuel consumption and output, still it is far from having reached its full development. In the discussion which followed, Mr. A. H. Wood, called attention to the fact that the output of the furnace at Cowan had been almost doubled recently by changing the "lines," by closer attention and heavier driving than formerly, and that the output of other furnaces of this company had been largely increased by heavier driving only, without change of lines. Major Lewis suggested that this increase was at the expense of the quality of the iron, but this assertion was denied by others.

Hunter McDonald, Secy.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The 43d annual meeting of the association will be held at Brooklyn, N. Y., Aug. 16 to 23. Vice-President Mansfield Merriman, head of the section of Mechanical Science and Engineering, will deliver an address Aug. 16 on "The Resistance of Materials under Impact," and a number of papers will be read and discussed at the following sessions on Aug. 17, 18 and 20.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—The first annual meeting of the society will be held at Brooklyn, N. Y., Aug. 20 to 23, in conjunction with the meeting of the American Association for the Advancement of Science. The program comprises a list of 25 papers to be read and discussed, and can be obtained from the Secretary, Prof. J. B. Johnson, Washington University, St. Louis, Mo.

COMING TECHNICAL MEETINGS.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
July 3. Secy., F. C. Osborn, Case Library Building.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
July 6. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
July 6. Secy., O. Von Geldern, 719 Market St., San Francisco.
NORTHWEST RAILWAY CLUB.
July 10. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
DENVER SOCIETY OF CIVIL ENGINEERS.
July 10. Secy., F. E. King, Jacobson Block.
NORTHWESTERN SOCIETY OF ENGINEERS.
July 10. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.
WESTERN SOCIETY OF ENGINEERS.
July 11. Secy., Thos. Appleton, Lakeside Bldg., Chicago.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
July 12. Secy., G. W. Shaw, Norton Building.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
July 12. Secy., C. H. McLeod, Montreal P. Q.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
July 14. Alleghany Springs, Va. Secy., J. A. Pilcher Roanoke, Va.
MONTANA SOCIETY OF CIVIL ENGINEERS.
July 14. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
July 16. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
July 16. Secy., M. F. Schinke, City Hall, Milwaukee.
ENGINEERS' CLUB OF MINNEAPOLIS.
July 16. Secy., E. Nexsen, 504 Kasota Block.
COLUMBIAN ENGINEERING SOCIETY.
July 17. Secy., F. W. Hart, Washington, D. C.
BOSTON SOCIETY OF CIVIL ENGINEERS.
July 18. Secy., S. E. Tinkham, 36 Bromfield St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
July 19. Secy., Howard Berge, 100 Washington St.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
July 19. Secy., Daniel Carhart, Carnegie Lib. Bldg., Allegheny.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS
July 20. 201 Washington Building.

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On another page of this issue considerable space is given to a description of the brakeshoe testing apparatus which has been constructed and erected at the Wilmerding shops of the Westinghouse Air Brake Co. for the use of the committee of the Master Car Builders' Association, appointed in 1893 to make laboratory tests of brakeshoes. This apparatus has been erected at the joint expense of the Master Car Builders' Association and the Westinghouse Air Brake Co., with the co-operation and aid of a dozen or more firms and engineers, who have given their time gratis and furnished material at the bare cost of manufacture. As completed it is probably the most elaborate machine for the purpose ever constructed, and the results of the tests to be made with it, if comprehensively and intelligently carried out, should be of unusual scientific and practical value. Very little is known regarding the friction of one metal upon another at high speeds and under heavy pressures. In the experiments of Morin, Poirer, Coulomb, Rankine and others, from which most of the data accessible to engineers are drawn, one or the other, and often both, of these conditions were lacking. The same is true of the later investigations of Capt. Douglas Galton and Mr. George Westinghouse, carried out in England in 1878, and those conducted within the past two or three years by the Chicago, Burlington & Quincy and Pennsylvania railways. These last tests were made on brakeshoes, and those of the Pennsylvania R. R. were road tests purely and simply. Most valuable information has resulted from all of these investigations, yet the conditions were such as to leave much to be desired in order to make the results acceptable for general use. It is to be the endeavor of the Master Car Builders' Committee to furnish data which shall represent as closely as is possible in a laboratory test the conditions of actual service, retaining at the same time the advantages of accurate measurements and uniform conditions, which are impossible in actual service tests. The apparatus is intended for testing brakeshoes only, yet, as will be seen, a very slight modification, easily made, will adapt it for general tests of other kinds and forms of materials, under varying conditions of pressure, velocity, time and surfaces, and doubtless means will be found to do this. In this connection it may be noted that the extent of our knowledge of journal friction is even less than of sliding friction. Practically no data are available bearing upon the friction of large journals carrying heavy loads. This fact is especially called to mind by the completion of the Halsted St. bridge over the Chicago River, as described in our issue of April 19, 1894. Here the entire weight of the bridge span and counterweights, some 600 tons, was to be carried on sixteen 12-in. journals, carrying 12-ft. rope sheaves. It was found, after careful search, that almost no data existed from which the friction of these journals could be calculated and it had to be figured on theoretical assumptions. This is evidently another fruitful field for study of the laws of frictional resistance, and any of our technical societies could do an important work for engineers in conducting a series of experiments upon the friction of journals under varying conditions of diameter, weight, etc. In the meantime, engineers will await with interest the results of the investigations of the Master Car Builders' committee.

The assassination of President Carnot, which has so shocked the civilized world, brings home with great force the fact that in these days those who occupy positions of authority must be prepared to face unflinchingly danger from unexpected sources and crises at unexpected seasons. As many men in the engineering profession well know, this is true at the present day not only of political rulers, but of those in charge of industrial operations. The courage, tact and generalship demanded from a superintendent who finds the property entrusted to his charge threatened by a mob of strikers, may equal that which a great military leader might display. Such a situation can give scope to the highest qualities of the individual; and deeds of heroism and valor are being daily enacted in these troublous times quite as worthy of honor as those performed in the heat of battle.

The fact is, and it must be courageously faced, that modern civilization is called upon to contend for its life with the forces that have grown up within it. The doctrine of the anarchist is that all existing institutions—governmental, social, industrial, religious—must be destroyed, and his weapon is trained against the lives of all those in authority. In treating such a doctrine, tolerance or compromise is out of the question, for it strikes at the root of all that the past centuries of civilization have accomplished. Fortunately such teachings are too monstrous and alien to the instincts of human nature to ever become widespread. The general impression that anarchism is securing great numbers of adherents is chiefly due to the rapid growth of socialism, a doctrine by no means kindred to anarchism, though so often confused with it in the popular mind.

In meeting the turbulent violence and resistance to law and order that are becoming so distressingly frequent, the safety of society is dependent on the firmness and courage of those who stand in positions of authority. The safety of life and liberty are dependent on the preservation of law and order, and any abdication of authority when peril threatens furnishes encouragement to the enemies of society.

But even more important than bravery when peril threatens is the tact that can avert the peril or make it impossible. We are still happily free from such anarchistic outrages as have shaken the French Republic, and our chief disturbances are the too frequent labor troubles. He is a wise master who so cultivates the good sense and discretion of those over whom he has authority, and so wins their respect and friendship, that either strikes will be averted, or, if they occur, they will be decided without the infractions of law which are becoming so common.

A good example of the eagerness of the general public to snap at any legislation tending to favor railway companies and criticise it adversely without much knowledge of its merits but simply because it seems to enlarge the powers of railways instead of restrict them, is furnished by the current discussion of the bill now before Congress prohibiting any one not having a license, or, in other words, ticket "scalpers," from dealing in railway tickets. One naturally expects to find much criticism of this character in the daily press, but hardly in the generally more thoughtful utterances of technical journals. We notice, however, that our valued contemporary, the "American Machinist," which is generally very careful in this respect, has fallen into an error in speaking of the bill referred to above. Briefly stated, our contemporary thinks that the law would prevent a man from selling a part or whole of a railway ticket which he does not wish to use, and, therefore, is an unwarranted restriction upon a man selling again what he has once purchased. If this were true there would be much force in the objection made, but the facts are, although they are not generally known, that all railway companies will redeem unused tickets or parts of tickets at any time. The law simply prevents the existence of a thousand and one irresponsible "scalpers'" offices, which are oftentimes nothing more than "fences" for the disposal of stolen goods and are always a direct encouragement to dishonesty on the part of both railway employes and the public, on account of the ease with which the pilfering of tickets may be concealed through them. It is unnecessary to detail the far more numerous instances in which tickets are diverted from the use for which they were designed and even defaced or altered, through these offices. Even if the tickets are honestly sold and used, the loss is more with the general public than with the railways. The "scalper" makes his living from the margin which he can obtain between his purchasing and his selling price, and therefore buys as cheaply as he can and nearly always at a much lower price than can be obtained from the railway companies themselves. The fact is, however, that while the railway companies have always held that the ticket "scalper's" business is illegal, they have always been culpable in neglecting to make it distinctly known to the travelling public that they will redeem unused tickets, and they therefore aid in continuing the business which they condemn.

PROJECTS FOR SHIP CANALS IN AMERICA.

We doubt whether the "oldest inhabitant" can recollect a time when projects for ship canals over all portions of this continent were more numerous than at the present time. Beginning on the east, we have the perennial Cape Cod canal scheme, now in the hands of a new set of capitalists, or would-be capitalists, who succeeded in making quite as much stir in the Massachusetts legislature this year as any set which has preceded them, and seem no more likely, so far as we can learn, to make any stir on the sands of Cape Cod.

Coming over to the Middle States, we have on the north the projected canal from the Hudson to the Great Lakes. The House Committee on Railways and Canals has been very generous this year, and has recommended an appropriation of $50,000 to make surveys for this canal, the alternative routes proposed being via the Erie Canal, and via Lake Ontario, the Oswego and Mohawk valleys. This latter route would involve a canal around Niagara, on the American side, as the members of the committee were strenuous that the traffic should not leave American territory.

Coming further south, we have the proposed ship canal across New Jersey, from Raritan Bay to the Delaware River at Philadelphia. It is urged as a strong point in favor of this canal that it would save time and expense to vessels entering and leaving Philadelphia, as compared with the present outlet to the sea via Delaware River and Bay; but as the canal would be 34 miles in length, on making reasonable estimates for comparative speed in the canal and in open water, it is difficult to see how the time of transit would be sufficiently lessened by the proposed canal to attract a very heavy traffic. However, as we have already recorded, Philadelphians are said to be interesting themselves in the project and are trying to raise funds to have surveys made.

A little further south we have the proposed Chesapeake and Delaware canal, a scheme in which Baltimore is taking quite an interest, as noted on our Engineering News page this week.

Further south still, we have the project for opening a chain of inland waterways all along the coast, their chief purpose being as a refuge for our lighter naval vessels in time of war. Of the ship canal across the Florida peninsula we have heard nothing for a long time; yet a canal here would have much in its favor, as the chain of waterways in the lake

region of Florida would aid in its construction, and vessels using it would not only considerably shorten their voyage, but would avoid the dangerous passage up the east coast of Florida. Along the Gulf Coast harbor improvements and not ship canals are the projects which attract public interest.

Returning to the region of the Great Lakes, we have first the Lake Erie & Ohio canal, again under consideration, and the House Committee has recommended a $20,000 appropriation for a survey. The traffic in sight for such a canal is a strong feature in its favor. So long as Lake Superior ore and coke from the Alleghenies are brought together to make Bessemer pig, a fair traffic seems assured for this proposed waterway.

Proposals to connect the Great Lakes with the Mississippi are numerous. The Fletcher bill, which has been also favorably reported by the House Committee, appropriates $10,000 for surveys to determine the most feasible route for a canal from some point on Lake Superior to the Mississippi River at or near the Twin Cities. Of course even the breezy enthusiasts of the Northwest do not propose to dig a ship canal over the whole 250 miles; but the plan is to utilize existing waterways, which would increase the distance to some 330 miles, by the route that is really most practicable.

We must not omit to mention that a canal is now actually in process of construction which will afford connection between the Great Lakes and the Mississippi, and that within a few years. We refer, of course, to the Chicago drainage canal.

Of projects to shorten the present Lake route there is a large number, including proposed waterways across the North Michigan peninsula to connect Lakes Superior and Michigan and one across the south peninsula to connect the south end of Lake Michigan with the west end of Lake Erie, leaving Huron out in the cold.

Going over to Canada we find promoters actively at work on the proposed canal from Georgian Bay to Lake Ontario, but thus far we believe without success in securing the necessary capital, although they have secured a franchise from Toronto for supplying that city with a water supply and with electric power. In fact, we believe this enterprise is now being pushed more actively than any other ship canal scheme on this continent.

Another Canadian scheme is the proposed route from Lake Huron to Montreal via the French River, Lake Nipissing and the Ottawa River. While it is not now being actively pushed, its possibilities are among the greatest of any canal scheme which we have named.

With respect to all these various schemes it must be said that the question of their feasibility as an engineering work is one question, their chance of commercial success is another; and the last question must be successfully met before capital can be secured. It must be shown to the satisfaction of investors: first, that any proposed canal can be constructed within the estimates made by reputable engineers; and, secondly, that the benefit to commerce is sufficiently great to attract a traffic that will pay tolls sufficient to return a fair income on the capital invested.

Even in the case of schemes where this can be fairly shown, however, we fear that promoters will find it uphill work to overcome the doubts of capitalists. The success of the Suez canal is offset in the public mind by the fiasco at Panama, by the failure thus far of the friends of the Nicaragua canal to secure private capital for its construction, and latest of all by the discouraging revelations with respect to the Manchester canal, just opened. The last enterprise was originally capitalized at £8,000,000. The contract for the construction of the entire canal was let to Thomas A. Walker for £5,750,000. The contract was abandoned at the close of 1890, at which time about £9,000,000 had been actually expended by the canal company, bonds having been floated to the amount of £2,407,000 in addition to the capital stock. At this juncture the aid of the city of Manchester was invoked, but the sum of £1,000,000 originally asked for grew as time went on until £5,000,000 had been absorbed. Thus this great waterway, 35 miles in length, a success from an engineering point of view, stands capitalized at about $70,000,000 in round numbers. The earnings originally estimated by the canal company were based upon a traffic of 3,000,000 tons per annum, to be carried at half the railway rates then current. On this basis a total gross revenue of $4,225,000 was figured, from which an annual expenditure of $880,000 was deducted for maintenance and operation, leaving net earnings of $3,345,000. Should this income be realized, those who have invested their money in the enterprise will have little reason to find fault; but changing existing channels of trade is always a slow process, and for some years to come the company will do well if it pays the interest on its bonds and meets its expenditures for maintenance and equipment.

It is worthy of note, as a matter of interest in this connection, that the rates of toll on the canal on which these estimates of revenue were based were from $1.05 to $1.75 per ton, a rate which must strike any one as excessive for the short distance of 35 miles, and which explain in part how so large an estimate of the revenue as that above given was made. Bearing in mind that bulk freight is actually carried on American railways at a cost as low as 0.4 ct. per ton-mile, it is easy to see that no canal in this country, competing as the Manchester canal does with existing railway lines, could hope to charge any such rates.

LETTERS TO THE EDITOR.

SAFETY PLUGS FOR LOCOMOTIVE BOILERS.—CORRECTION.

Sir: In your issue of June 14 in the article on efficiency of crown plugs for locomotive boilers, I notice you have been misled by a typographical error in the report of the Southern & Southwestern Ry. Club. The figures in the latter portion of the second column, p. 499, and in the paragraph ending at the top of the third column, should not have been pounds of water, but 0.24 in., 0.12 in., 0.44 in., 0.77 in. and 0.89 in. I call your attention to this, as the importance of quick action on the part of the safety plug will be better understood when it is seen how rapidly the water passes away from the boiler when the injector is shut off and the engine is working under steam.

Yours truly, R. P. C. Sanderson.
Div. Supt. of Motive Power, Norfolk & Western R. R.
Roanoke, Va., June 18, 1894.

THE PHILADELPHIA ASPHALT TESTS.

Sir: In your issue of June 21 you have done us the honor to reprint most of our report on the asphalt pavements, with comments of two chemists as to our conclusions. As these criticisms were not submitted to us for reply before publication and they seem to take exception to some of our conclusions, I will ask your indulgence as to the engineering part of the report, leaving the chemical portion for our experts in that profession.

Professor Richardson has misconstrued our purpose, as we were not comparing recently laid Bermudez with much older Trinidad as laid in Washington, but Bermudez with Trinidad of the same age, and Trinidad in Washington with the same in Philadelphia, and our conclusion was inevitable that the quality of the latter in this city was inferior to the Trinidad of Washington. The investigation was without professional bias and was conducted with the intention of aiding in reaching correct conclusions. While it was true that no "cracks, pockets or depressions" existed in the Bermudez of Washington, no matter what its age, the same cannot be said of our recent pavements here, for repairs are already in vogue on pavements laid within two months.

Only yesterday a number of men with levers and handspikes were observed prying the wheels of a team out of the soft asphalt into which they had sunk under the influence of a warm sun. This street has been opened about one month. Yet Professor Richardson says:

> The true deduction from the expert figures is, that at both temperatures given, Trinidad asphalt is the most yielding and would resist impact better and consequently prove a more valuable cement for paving purposes.

In my opinion practice does not confirm this conclusion, as he fixes no minimum limit, and the instance above cited seems to show that Trinidad may be too yielding even to resist pressure, to say nothing of impact. If the earlier recommendations of this expert were carried out, there could be no competition and but little improvement in any asphalt pavements. The agitation in this city has resulted in four competitors and a reduction in price of about 45 cts. per sq. yd., from which we expect more durable pavements.

From the editorial comments we see that the "bituminous" foundation is not well understood. It is not even so good as your excellent paper would make it, for instead of being a layer of broken stone over which coal tar is poured till the interstices are filled, it is a layer of broken stone but 4½ ins. deep with no matrix or cementing material, but dashed with a broom to the extent of one gallon of tar to the superficial yard. The total depth being but 9 ins., it cannot be expected that with such a substructure the pavement will last any considerable time, and hence the guarantee is limited to but three years, after which the city takes up the burden of repairs.

Very respectfully, Lewis M. Haupt,
M. Am. Soc. C. E.
Philadelphia, June 23, 1894.

Sir: It is interesting to note in the last issue of Engineering News that two of your correspondents are considerably excited over a little series of asphalt tests which were recently made in this city, and that even the editorial mind is a bit disturbed. In order that the facts may be clearly appreciated by your readers, allow me to explain, that the city of Philadelphia has been paying high prices for what was generally considered to be a very poor quality of asphalt pavement, and that one contractor virtually had a monopoly of the business because the city specifications called for Trinidad asphalt. As everybody knows, the Trinidad asphalt is really a monopoly, since the product is entirely controlled by a company which holds a concession for a long term of years from the Government of Trinidad.

Under these circumstances, there was a very strong popular sentiment demanding that the specifications should be changed so as to admit of competition in paving the streets. The city authorities rather objected to making any change in this respect, on the ground that they had had no experience and very little information in regard to the other asphalts offered. The Citizens' Municipal Association and the Trades League of the city decided, therefore, to conduct an investigation which would develop the facts in regard to other asphalts, and the result of this determination was the report which you have quoted in your last issue.

The tensile and compression tests were made at the suggestion of Dr. Sadtler, and it was originally expected that several other brands of asphalts would enter for comparative tests. The result of the popular agitation of the subject, however, was that the city officials, like the proverbial coon, decided to come down before the gun went off. The main point being thus gained, no other asphalts entered into the tests except the Trinidad and the Bermudez, which were already committed in the matter.

Your correspondents have a good deal to say about the way these mixtures were made and about the expertness, or lack of expertness, of the people who conducted them; but the facts are these: The Trinidad people furnished samples of their refined asphalt, of their oil residuum, of the sand they used, and of the powdered limestone; with a prescription of the proportions in which they were to be mixed, and the temperature to be used. The Bermudez people did exactly the same thing. Each company was invited to send its representative, if it desired to do so, and the Department of Public Works was also invited to send a representative.

The test specimens were thus made up under the conditions which each party claimed to be most favorable to its product, and they were made up in the presence of all parties interested who cared to be present.

Of course the parties instrumental in making these tests can hardly be expected to define exactly to what extent they may, or may not be, expert in this class of work, but it is well to say emphatically that they represented no commercial interest, had no axes to grind, and that the finding of their report was simply and solely to sustain the popular demand in favor of competition in paving contracts.

On this latter point the criticisms of your correspondents are quite immaterial. Admit, if you will, that the crushing test is of little value, or that the tensile strength is not the proper criterion; grant, even, that the tests made do not prove anything in regard to pavements, and yet it must be conceded that the data collected, taken as a whole, strongly justified the experts in reporting favorably as to competition in asphalt paving. It is precisely because this conclusion is so clear that the adverse interest is endeavoring to shake it.

Let me add that the result of the agitation of this matter in Philadelphia has been very satisfactory. The contracts awarded this year were at lower rates than heretofore, the guarantee is longer, and the pavement is very much better, since it is all to be laid upon a base of hydraulic concrete instead of the so-called bituminous concrete. Three different companies will be patronized and three different brands of asphalt will be used, the Trinidad, the Bermudez and the Alcatraz.

The good people of the Quaker City are highly pleased with these results, even though it may have caused your conservative correspondents in New York and Washington to think them hasty or even a little reckless.

Frederick H. Lewis.
Philadelphia, June 23, 1894.

STEEL PIPES FOR SEWERS.

Sir: It is now maintained, by some of the manufacturers at least, that sewers of riveted steel pipe, properly coated with pure asphalt or P. and B. pipe coating compound, are in every way satisfactory. It is claimed that for large sewers this pipe is cheaper than brick, lasts longer, will not cave in, and presents some other practical advantages. I should like to know what is thought of this matter by engineers.

John W. Gray, City Engineer.

Oakland, Cal., June 2, 1894.

(One of the first questions to be settled before adopting steel pipes for sewers in a city would be whether the sewage carried a sufficient amount of acid or alkaline matter to cause corrosion, and whether the steel could be so protected as to prevent corrosion. Another question to be considered would be the relative cost of steel and cast iron pipe. Both steel and cast iron can now be bought at marvelously low figures, but the actual difference in dollars between the cost of the two kinds of pipes is less than ever before, while the fact that most sewer work is done in streets and comparatively accessible localities renders of less importance the fact that steel pipes are lighter and can be more easily handled. The advantage of cast iron is that it resists corrosion better, and furnishes a greater thickness of metal which must rust away before leakage will occur.—Ed.)

VARIATION OF COMPASS NEEDLES.

Sir: The letter of Mr. Hodgman in your issue of May 31 calls my attention anew to the fact that very few works on surveying make any mention whatever of the fact that different needles do not agree. It has always seemed strange to me that such a fact—and one that has been known at least since the time of Rittenhouse—should receive so little notice. Many surveyors of considerable experience seem to be entirely unaware of the fact, and, when a difference is observed, at once infer that one or other of the instruments is imperfect. My first knowledge of the fact was derived years ago from an old copy of Flint's "Surveying."

Yours truly, O. H. Tripp.

Rockland, Me., June 2, 1894.

(We apprehend that comparatively few engineers will accept without further proof the claim that there is a variation in the reading of different compass needles, which cannot be explained by minute variations in needle, pivot or arc. The force of magnetism which acts on one needle is the same (in kind at least) as the force that acts on another, and it will hardly be claimed that the earth's magnetic pole is not the same for one magnet as for another. Of course no one can say positively that such variations as are claimed above may not occur, but the variations which have been described in the preceding correspondence might all have been due apparently to very small mechanical differences.—Ed.)

BRIDGE ENGINEERS AND SUPERINTENDENTS.

Sir: In your notice of the report of the Massachusetts Board of Railroad Commissioners, in your issue of May 31, I read that Professor Swain's report states that on the Boston & Maine R. R., and the New York, New Haven & Hartford R. R., the oversight of all bridges has been transferred from the chief engineer or bridge engineer to the division superintendents. From the subordinate position which the engineering department holds on many railways, it would be well to abolish it entirely.

Disgusted Engineer.

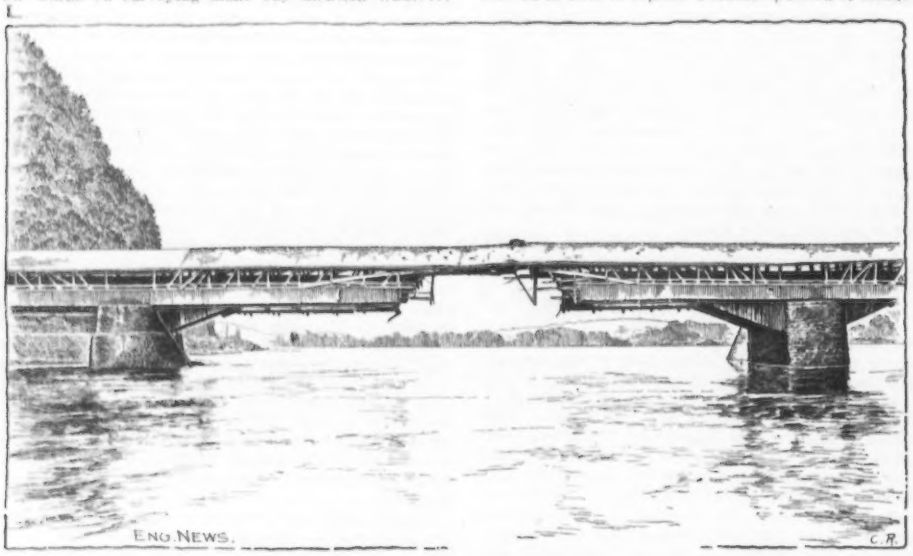
(Many roads have done so, and there is this at least to be said in favor of the above noted action, that it is well that authority should rest in form where it does in fact, and not be divided. The tendency to such action is certainly a regrettable one. In principle at least there can be no question that it is wrong.—Ed.)

ACCIDENT TO A 200-FT. WOODEN BRIDGE SPAN.

Sir: The accompanying photograph represents the damaged portion of the Pennsylvania Canal Co.'s towpath and highway bridge, crossing the West Branch of the Susquehanna River at Northumberland, Pa., as the result of floating wreckage and stray boom logs brought down by the great flood of May 21 last. The bridge consists of six spans, each 200 ft. clear length between piers, is of the Burr truss pattern, with arches; it has two roadways, and an extension 7 ft. wide on the down stream side to serve as a towing path for boat teams.

The wreck as shown is in the middle of the second span from the south end of the bridge and represents about 75 ft. in length of the structure entirely destroyed, including in that portion the lower chords, posts, braces, all of the arches, and a portion of the top chords; the top laterals and roof remaining in part. The spans are connected one with another at the piers, and this feature alone is assigned as explaining the fact that the span remains standing as shown.

I may state in this connection that the bridge was erected in 1889 to replace a similar pattern of bridge destroyed by a flood in that year. The dimensions of the superstructure are: Height out to out of chords, for middle truss, 21½ ft.; for outside truss, 16½ ft.; width, 28 ft. c. to c. of outside trusses.



ACCIDENT TO A 200-FT. WOODEN BRIDGE SPAN.

Yours respectfully, T. T. Wierman, Jr.,
Chief Engineer Pennsylvania Canal Co.

Harrisburg, Pa., June 19, 1894.

A FILTER PATENT DECISION AND FILTRATION AT PROVIDENCE.

Ordinary sand filtration may be adopted for the water supply of Providence, R. I., instead of the mechanical filtration system, noted in our issue of June 7, but nothing definite has been decided in the matter as yet. The change of system has been made probable by a recent decision by Judge J. C. Shipman, of the U. S. Circuit Court for the Southern District of New York. The decision was rendered in a suit originally brought by the New York Filter Co. against Henry Schwarzwalder on account of filters of the Jewell type used in the Murray Hill Turkish Baths, of New York. The O. H. Jewell Co., of Chicago, took up the suit in defence of its patron. The alleged infringement is the use of alum, or, perhaps more properly, sulphate of alumina, as a coagulant to aid in removing foreign matter from water by rapid filtration through sand. The decision appears to hold that the use of any coagulant which causes the formation of hydrates upon sand filter beds, with filtration at a rapid rate, is an infringement of Patent 293,740, granted to Isaiah Smith Hyatt, on Feb. 19, 1884, notwithstanding a subsequent disclaimer filed by the inventor excluding aluminum salts. The decision also seems to indicate as permissible the use of any of these coagulants in large quantities and with slow rates of filtration for the purification of water not intended for drinking, or for the purification of sewage. This latter is to be inferred, merely, the main point being that the use of sulphate of alumina in the particular Jewell filter named is forbidden.

The effect of this decision on the Providence scheme may be easily understood after the statements: (1) That the city proposed to contract with the Morrison-Jewell Filtration Co., of New York, for a Jewell filter plant, which system a special investigating committee had recommended, and to use sulphate of alumina as a coagulant. (2) The city engineer of Providence, Mr. J. Herbert Shedd, M. Am. Soc. C. E., who was one of the investigating committee, appears to favor the use of sand filter beds, instead of mechanical filters. (3) Finally, it is reported that Mr. Shedd has secured plans for a so-called natural filtration plant and obtained an estimate for building such a plant for $200,000, against $281,000 for the mechanical system, and with an estimated cost of operation of $10,000 for the beds, against $30,000 for the mechanical filters. The beds proposed are six in number, each 150 × 300 ft., giving an effective area of about 6½ acres, and designed to filter 15,000,000 gallons of water daily. Brick underdrains are proposed, covering the whole bottom area of the beds, and similar to those used by the New River Co., of London, and by the water-works of Ilion, N. Y., as described in our issue of June 7. Aside from Mr. Shedd, the other members of the investigating committee were Mr. Robert E. Smith, Superintendent of Public Works, and Health Commissioner Chapin. A general invitation was extended for the submission of systems of filtration for experiment and a long and careful series of experiments were made on both mechanical filters and simple sand filtration. Mr. Edmund B. Weston, M. Am. Soc. C. E., assistant in charge of the water department, had direct supervision of the experiments, and is reported as expressing himself unofficially as in favor of "natural filtration," but as being of the opinion that a 15,000,000-gallon plant of this type cannot be built for less than $500,000. It may be stated here that the filter beds at Lawrence, Mass. (See Eng. News, Aug. 3, 1893), with an available area of 2½ acres and a daily capacity of 5,000,000 gallons, cost $65,000, or $13,000 per million gallons.

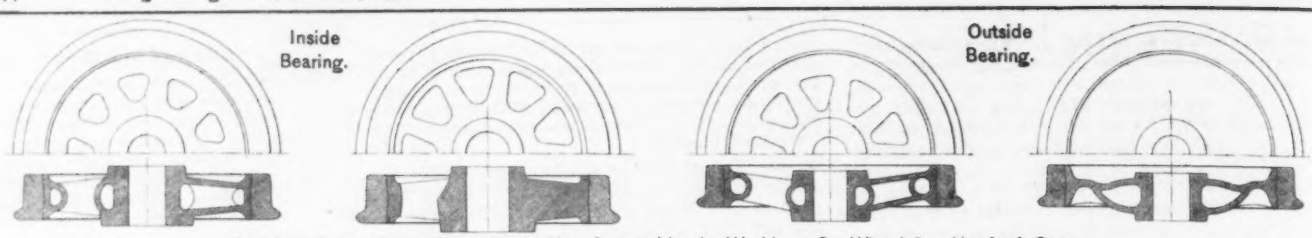
The New York Filter Co., prior to the decision referred to, had served notice on the city of Providence that the proposed system was an infringement on patents held by the company and the Morrison-Jewell Filtration Co. had offered to give bonds to protect the city. The decision, although the case has been, or probably will be, appealed, apparently deters the city from using the Jewell patents and will lead it, it appears, to pass by all other mechanical filters and take up simple sand filtration.

ATALANTIS AND HOW IT WILL BE BUILT.

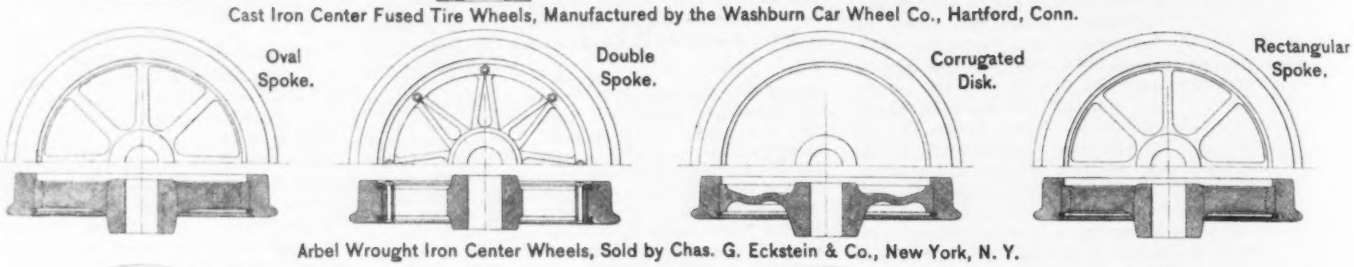
A good deal has appeared in the newspapers of late concerning the scheme of building a summer hotel on piles in the open ocean, at a point about 16 miles east of the Highlands of Navesink, and 13 miles south of the Long Island shore. In our issue of June 7 we made reference to the scheme, taking our data from the press reports, and stated that as the depth of water where it was proposed to found the structure was some 200 ft., the construction would be decidedly interesting. We are now informed that the depth of water on the site of the structure is some 66 ft., a difference of considerable moment, and one which makes the construction rather more interesting than less interesting to engineers, since it materially increases the probability that the work will actually be undertaken and carried forward to success.

Through the courtesy of one of the gentlemen interested in the enterprise, we are enabled to present to our readers a detailed description of the methods by which it is proposed to carry out this novel undertaking.

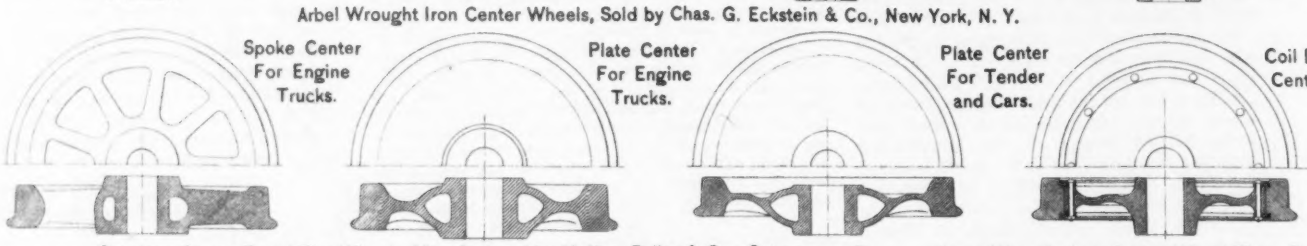
The completed structure, in the first place, is to rest on 36 cast iron cylinder piers, each 10 ft. in diameter and about 140 ft. in height. Of this total



Cast Iron Center Fused Tire Wheels, Manufactured by the Washburn Car Wheel Co., Hartford, Conn.

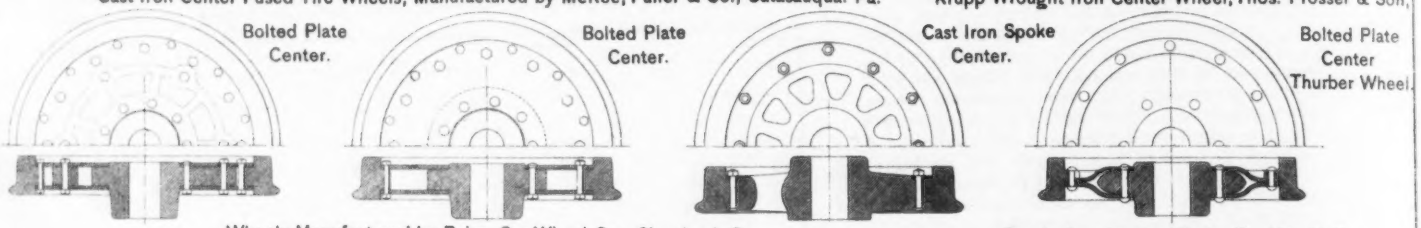


Arbel Wrought Iron Center Wheels, Sold by Chas. G. Eckstein & Co., New York, N. Y.



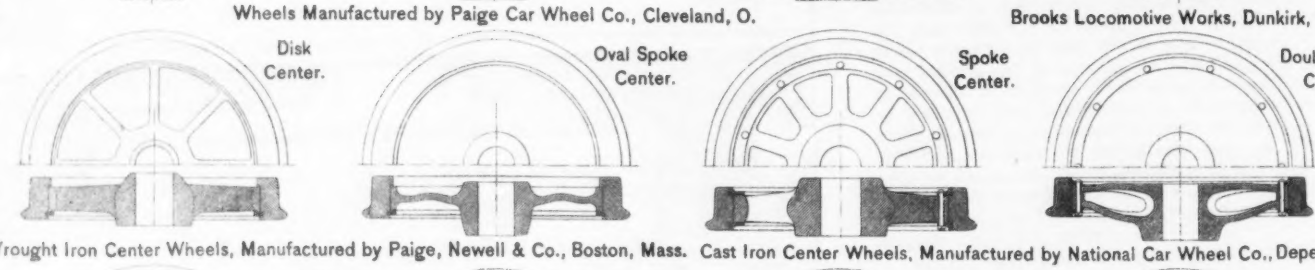
Cast Iron Center Fused Tire Wheels, Manufactured by McKee, Fuller & Co., Catasauqua. Pa.

Krupp Wrought Iron Center Wheel, Thos. Prosser & Son,



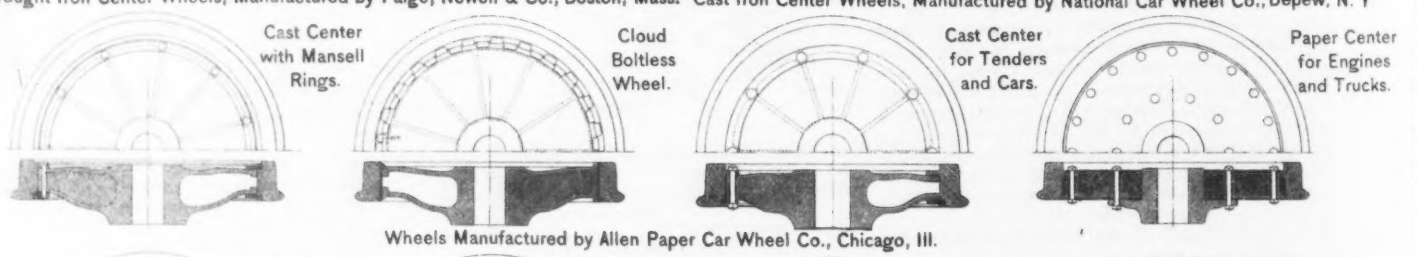
Wheels Manufactured by Paige Car Wheel Co., Cleveland, O.

Brooks Locomotive Works, Dunkirk, N. Y.

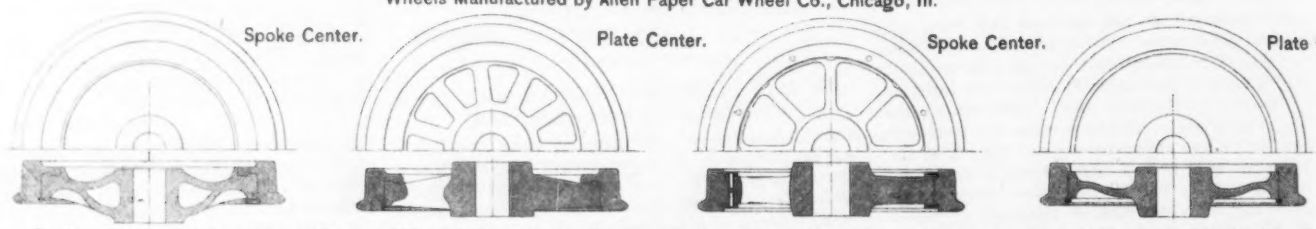


Wrought Iron Center Wheels, Manufactured by Paige, Newell & Co., Boston, Mass.

Cast Iron Center Wheels, Manufactured by National Car Wheel Co., Depew, N. Y

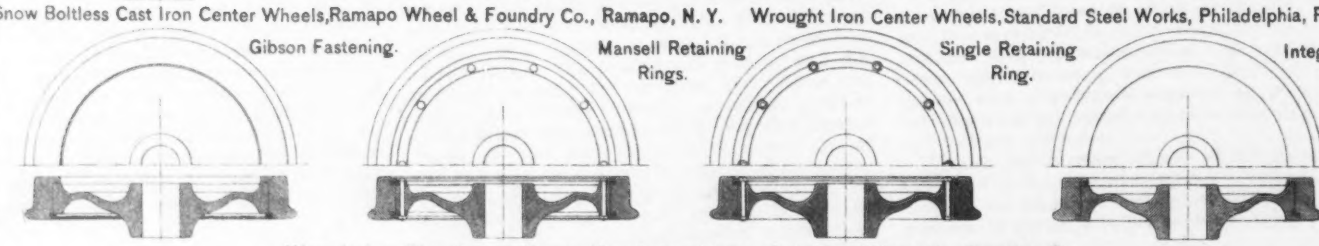

Cast Center with Mansell Rings.
Cloud Boltless Wheel.
Cast Center for Tenders and Cars.
Paper Center for Engines and Trucks.

Wheels Manufactured by Allen Paper Car Wheel Co., Chicago, Ill.



Snow Boltless Cast Iron Center Wheels, Ramapo Wheel & Foundry Co., Ramapo, N. Y.

Wrought Iron Center Wheels, Standard Steel Works, Philadelphia, Pa.



Wrought Iron Plate Center Wheels, Manufactured by the Boies Steel Wheel Co., Scranton, Pa.

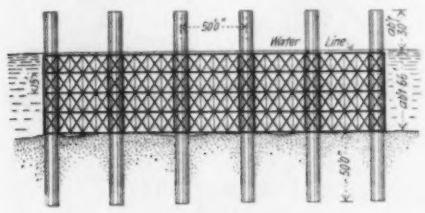
Steel-Tired Wheels in Use in the United States.

Collected by a Committee of the Master Car-Builders Association.

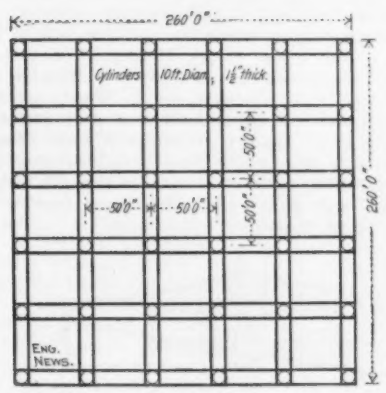
CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

height 50 ft. will be the depth of the bottom of the cylinder below the surface of the sand shoal; 60 ft. represents the depth of the water, and the top of the piers, on which the structure above will be constructed, will be some 30 ft. above the water surface.

The process of construction planned is as follows: The cast iron cylinders will first be built up into lengths of some 20 ft. and will be framed together by a rectangular system of Howe trusses, arranged as shown in the accompanying plan and elevation. This whole structure will be built on sliding ways and when one or two vertical panels of the trussing are completed, each cylinder will be provided with a secure false bottom, and the whole will be launched. The cylinders will have a large surplus buoyancy and the Howe trusses will probably a



Elevation.



Plan.

Plan and Elevation of Foundations for Proposed Atalantis Hotel, to be built in the Open Ocean.

little more than support their own weight. After the structure is safely in the water, construction will continue on both cylinders and trussing until the cylinders have a total length of 80 ft. and four vertical panels of trussing are in place. It will then draw about 30 ft. of water, and although it will be not exactly a speedy craft, it will be wholly uncapsizable, as its width is so much greater than its depth.

It is then proposed to tow this great structure out to sea, to the site it is to occupy. When in proper position water will be allowed to flow into the cylinders and the whole will be sunk until it rests on the bottom, at which time 10 to 20 ft. of each cylinder will still project above the waves.

With this part of the proceeding safely accomplished, the rest is simple work. The clamps on one cylinder after another will be loosened, the false bottoms will be removed, and each will be sunk by dredging from its interior until the desired depth is reached, the top being built up as the bottom goes down. Then the interior will be filled solid with concrete.

The trussing, extending from the water level to the sand shoal, will remain in position, furnishing an effective bracing to the structure and binding all into one solid whole while construction is in progress and until the cylinder piers are securely anchored by the weight of the structure above. It is argued that when this is done the structure will be stable enough to withstand the force of the waves without the bracing, which can be safely left to the tender mercies of the teredo. If, however, it be deemed best to preserve the bracing, it can be built of creosoted lumber, or a truss of cast iron pipe could be used. The cylinders for the piers will be cast in 6 to 8 ft. lengths and joined together by interior flanges, so as to permit the completed cylinder to slip freely in the bracing when unclamped. The framing would consist of lines of 12 × 12-in. timbers with a Howe truss system of bracing between them.

The details of this plan for carrying out what will universally be conceded to be a very difficult enterprise are chiefly the work of Mr. John Anderson, of the firm of Anderson & Barr, which has taken the contract for the construction of the foundation complete. The reputation of Anderson & Barr for making a success of difficult work of this class is such that the results of this new and novel enterprise will be awaited with interest.

The projectors of Atalantis include Capt. R. D. Evans, U. S. N., of the Lighthouse Board, and Mr. C. M. Coen. The engineers of the company are Messrs. James C. McGuire and Capt. Howard Patterson. The headquarters of the Atalantis Co. are at 3 Union Square, New York City.

THE SANDROCK SEWERS OF ST. PAUL.*

By George L. Wilson, Asst. City Engineer.

St. Paul is situated on both sides of the Mississippi River. A portion of the city area, 90 to 100 ft. above the river, 1-5 to ¾ mile wide, and 2½ miles long, is of peculiar geological formation. This plateau consists of Trenton limestone, which is easily disintegrated, overlaid by clays and alluvium. Beneath the limestone is the St. Peter's sandstone. This is a nearly pure quartz sand, which is easily picked and shoveled without blasting. It is about 130 ft. in thickness and nearly level. In this sandstone the subways for sewers, water mains and telephone conduits are excavated. In 1873 the city first began excavating for sewers in this sandrock and building them with a brick invert, and all now have the bottom line with brickwork, usually of a parabolic section. All tunnels have a clear height of 6 ft. The main sewer runs the entire length of the sandrock, and acts as an interceptor for the dry water flow, while the storm water passes off through overflows. The brick invert is of sufficient capacity to carry the ordinary flow and light showers. The storm water which sometimes rises above the brickwork does not cause appreciable scour. In some places, however, the sandrock requires complete lining.

The grades range from 0.1 ft. to 10 ft. per 100 ft. On the steep grades granite lining is used. In passing from an open cut surface sewer on the high ground to the sandrock sewer, a vertical drop in a granite-lined shaft is generally used, although sometimes a slope is introduced, where the depth is not too great. The limit of economical construction is where the grade brings the roof against the overlying rock, or the depth of the limestone above is too great. The depth through the sandrock district varies from 26 to 60 ft. from the surface. In the construction shafts are sunk 300 to 600 ft. apart, built up with brickwork, with manhole covers and iron ladders.

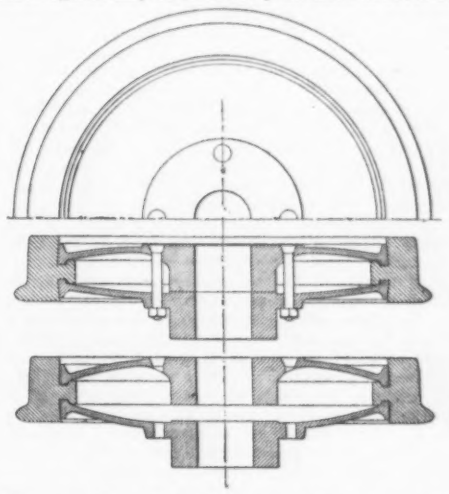
The lines are transferred from the surface by plumb nuts in the shafts, and fixed by wooden plugs placed in the roof. Drifts are opened through between shafts and trimmed to form, and the bottom carefully shaped for the brickwork. Usually no ventilation is required during construction. The cost of excavating and moving the waste, including tools and lights, averages $1 per ft. for small sizes, and $3 per ft. depth of shaft. The average cost per foot for all sizes can be put at $3, which includes shafts and catch basins. There are 20 miles of these subways in the city at present. House connections are made for 85 cts. per lin. ft. These are connected with the main sewer through a small tunnel at right angles with the street in which a 6-in. or 9-in. vitrified pipe is run. In making connection to water pipes a drift is run out at right angles from the street under the building to be connected, and a drill hole made from the cellar to the drift. For telephone subways distribution is made to subscribers by one connection in each block, and surface wires are run in the block.

STEEL-TIRED WHEELS IN USE IN THE UNITED STATES.

(With Inset.)

The question of the comparative advantages of different types of steel-tired wheels, and their safety and durability as compared with the cast iron wheels, which have been so largely used in this country, under passenger cars as well as under freight cars, have received considerable attention from American railway officials within the last few years. In European countries, as is well known, steel-tired wheels are almost universally used. With the view of gathering some definite information regarding the several types of steel-tired wheels in use in the United States, and of determining something about their efficiency in actual service, the Master Car Builders' Association appointed a committee of its members about a year ago to investigate and report upon the construction and use of such wheels. This committee presented its report at the annual convention just held at Saratoga, N. Y., as noted in our issue of June 14. Drawings showing the construction of 33 different wheels were given in the report and are reproduced on our inset sheet this week, as showing very clearly the present practice of steel-tired wheel construction for railway cars.

The report, which is very brief, contains statistics covering 17,562 cars, or about 57% of the total passenger car equipment in the country, and it appears that about 36% of the wheels used under these cars are steel tired. As it is probable that a very large proportion of the roads which made no report were those which make no use of steel-tired wheels, these figures may be reasonably assumed to cover at



Wrought Iron Plate Centered Wheel, Manufactured by the Boies Steel Wheel Co., Scranton, Pa.

least 80% of the steel-tired wheels in use in the United States. Of the wheels in use whose construction was definitely reported, 55.4% are bolted plate wheels, 14.8% are spoke wheels and 29.8% are disk or solid plate wheels. In respect to the efficiency and durability of the different types, the figures given in the report are hardly comparable, as the number of bolted plate wheels reported is much larger than that of either of the other types. The testimony of the members of the association, however, as to the type giving the best satisfaction is as follows:

	Number of members.	No. of steel-tired wheels in use.
Bolted plate	16	25,335
Spoke	4	3,196
Disk or solid plate	15	15,363
Not given	27	23,706
Total	62	67,000

BULLET-PROOF ARMOR.

As was recently noted in these columns, a great deal of interest has been excited in Europe over the reputed invention by a German tailor of a bullet-proof cuirass. The material of which this cuirass is made has been kept a profound secret, and this, perhaps, is one reason for the generous advertising which the reputed invention has received. It must be remembered, also, that in lands where every able-bodied man has to spend some portion of his years in military service and knows that his country is at any time liable to be plunged into war, anything which promises to diminish the risk of such service possesses a very vital interest for every one.

Recently the German tailor, Dowe, and his backers came to England to exhibit his invention, and Mr. Hiram Maxim, the well-known inventor, after examining the Dowe cuirass, came to the conclusion that it was nothing more than a metal plate, with its surface concealed by some textile material. The rest of the story is told by Mr. Maxim as follows in a letter recently published in our British technical contemporaries:

Sir: During the past few months a great deal has appeared in the English press concerning a new "bul-

* Abstract of paper read at the convention of the American Society of Civil Engineers at Niagara Falls.

let-proof cloth," or a "bullet-proof coat," which has been invented by a German tailor. A couple of showmen brought the German and his alleged invention to England for the purpose of exhibition before the British public. The device, however, instead of being a bullet-proof cloth, was, in my opinion, simply a piece of armor-plate sewn up in a bag. Had it been brought and exhibited at a music hall as a clever juggling trick, it might have been highly amusing to the unscientific who are not acquainted with the laws of dynamics, but they were not content to exhibit the thing in its legitimate sphere; they entered the realm of science, claimed that it was a new scientific discovery, and succeeded in getting some of the best men—from His Royal Highness the Commander-in-Chief, down—to see their experiments. The great number of high officials and scientific and technical men who went to see it, and the publicity that was given to it by the press, brought it before everybody, and the claim set forth was an open challenge to me as much as to any other scientific man in England. I saw the trick at once, and claimed that I had something better and lighter, the secret of which I would sell for 7s. 6d. cash, and that the substance which I proposed to use was a compound of organic and inorganic matter. This was set forth in a letter which I wrote to the newspapers, and I offered to show my alleged invention and to sell the secret on a certain day. On that occasion, the London terminus of the railway that runs to Erith was simply overwhelmed with people wishing to go to Erith, and the number that went was only limited by the transportation facilities that the railway was able to offer. Many went to towns near Erith and walked across country. Some of my friends who were on the train have informed me that every one was talking about it, saying that Mr. Maxim was a very clever man, that he had probably made a very marvellous invention, and that ironclads would probably go out of use, because he probably had some very light bullet-proof cloth that would resist all kinds of shots, even large guns. One gentleman was anxious to have a complete suit of Mr. Maxim's new cloth to wear under evening dress, so that he could stand up and be shot at from all sides with a military rifle to amuse his friends. I must confess I had not the remotest idea that my 7s. 6d. cash secret would be taken in such dead earnest.

The crowd that assembled at Erith was so great and so unruly that it was impossible to conduct the experiments in anything like a satisfactory manner, and notwithstanding that I had a considerable number of men to assist me, the crowd broke down all barriers, mounting my table, and swarming over everything. I had provided myself with scales and a 2-ft. rule, and I asked the gentlemen to stand back and allow me to show them what my cuirass measured and how much it weighed. I said I had agreed to make something which would beat Herr Dowe's cuirass, and to employ certain organic and inorganic substances, and I had found that the most suitable inorganic substances were iron and nickel, and for the organic substance a small percentage of carbon. When, however, they found out that my cuirass was nothing but a steel plate in a bag, that the process of manufacture which I described to them was nothing but the process of steel-making, they were exceedingly indignant, and about 100 of them, headed by a very pompous officer, who had come down with two orderlies, left in a great huff. They were perfectly furious, and said they had been sold. About 600 remained behind, and a large number of shots were fired at the cuirass, which had a larger protected area for its weight than Herr Dowe has ever shown. It was simply a piece of very fine highly tempered steel ¼ in. thick. Two shields were shown, one sewed up in a bag and the other covered with felt.

At Herr Dowe's demonstration on the night of the 5th inst. to prove that his cuirass was all that he claimed for it, the area actually fired at was about 8 ins. by 11 ins., and it was claimed that the weight was 11¾ lbs. They, however, would not submit to the 2-ft. rule and scales.

We are now able to provide armor-plates for the Maxim guns which will stop the small-bore projectile, and which weigh 7 lbs. per sq. ft., and this I think all scientific men would be willing to back against all other substances, weight for weight.

I hear from Germany, on pretty good authority, that Herr Dowe's armor-plate is a piece of very hard aluminum bronze, but this, as we all know, is never quite as strong as good steel. The amount of abuse which I have received for giving away this little trick is simply wonderful. Had I been a pirate and sunk half the ships on the Thames it could not have been worse.

Yours truly, Hiram S. Maxim.

June 6, 1894.

From other accounts in "The Engineer" and "Engineering," it appears that the German tailor and his backers deny that their cuirass contains a particle of steel or iron, but whether it does or not seems apart from the main point, as Mr. Maxim has so cleverly shown. The question of the utility of shields merely resolves itself into the question whether sufficient protection can be obtained within the allowable limits of weight to make their use worth while.

THE RESULTS OF THE BUDAPEST BRIDGE COMPETITION.*

Last July the Royal Hungarian Ministry of Commerce ordered an international competition for two highway bridges over the Danube at Budapest, near the squares Eskuter and Fovamter. Excellence of architectural treatment as well as good engineering design was demanded for both bridges, but especially for the Eskuter bridge, which is located in the center of the city, and near a famous suspension bridge. On account of the considerable river traffic, it was stipulated that the erection must be done without falseworks in the river. The cost of both bridges, exclusive of approaches, was not to exceed $2,000,000.

Both bridges were to be designed, if possible, with one span each, which was to be 1,027 ft. for the Escuter and 1,087 ft. for the Fovamter bridge. If the cost of each bridge should much exceed the sum of $1,000,000, the Fovamter bridge (and if necessary, the Escuter bridge also) was to be built with three spans, with a central opening of about 575 ft. The bridges were to have a clear height of 47½ ft. above mean low water for a distance of 164 ft. either side from the central line and then to decrease gradually to 33 ft. at the piers and 29½ ft. at the abutments. The clear width of roadway was set at 34 ft., with two 10-ft. sidewalks. In the roadway were to be provided conduits for a double trackele ctric street railway.

The bridges were to be calculated for a uniform load of 92 lbs. per sq. ft., and for a concentrated load of two wagons alongside of each other, with wheel loads of four tons for the Eskuter and of six tons for the Fovamter bridge.

A maximum wind pressure of 51 lbs. per sq. ft. of lateral surface of the unloaded part of the bridge was to be provided for.

The admissible stresses were:

For iron:		
In trusses	12,800	lbs. per sq. in.
" floor system	9,960	" " " "
For mild steel:		
In trusses	14,230	lbs. per sq. in.
" floor system	10,670	" " " "

Competitors were required to submit their plans, which had to be in considerable detail, by Jan. 31, 1894. The award was to be made by a special board of experts. A first and second prize of $6,000 and $4,060, were to be given to the two best designs for either bridge. If the best project for a one-span Eskuter bridge could be executed for a sum not largely exceeding $1,000,000, it should receive, beside the first prize, an additional one of $2,030.

The interesting problem induced a great many engineers to compete. From Austria-Hungary, Germany, Italy, France, England and the United States, a total of 74 designs were sent in by 62 competitors. Of these plans, 53 projects were for a bridge at Eskuter, 38 with one opening and 15 with three spans; of the remaining 21 plans, 5 showed a Fovamter bridge with one span and 16 such a one with three spans.

Fully 50 of the designs were laid aside on account of obvious deficiencies as to construction and aesthetics. The jury finished its work on May 24, and all designs were then publicly exhibited.

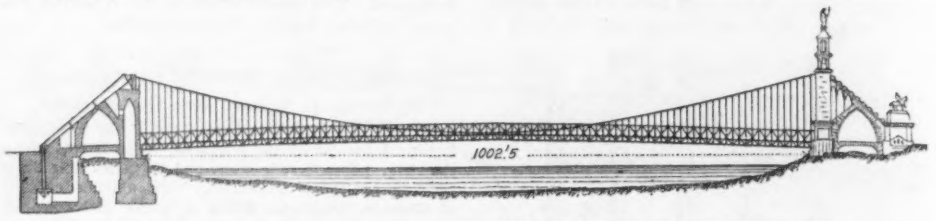


FIG. 1. FIRST PRIZE DESIGN; ESSLINGEN-STUTTGART MACHINE CO.

The first prize was awarded, by a vote of 16 to 14, to the design of the Esslingen-Stuttgart Machine Co., which has as authors J. Kuebler, chief engineer of the company, and P. Weigle, architect. The plan, Fig. 1, represents a wire suspension bridge of the type of the bridge over the Saane at Fribourg. The stiff outwardly inclined suspension members of angle irons carry a through highway bridge with floor system of ordinary construction. The latticed trusses which serve to stiffen the cables, and are placed outside of the sidewalks, are 20 ft. deep. The trusses rather impede the desired free view from the bridge. The cables, which consist each of about 14,000 galvanized steel wires of 4 mm. diameter, strained to about 45,000 lbs. per sq. in., pass over rocker bearings on high and ornate stone towers, running down to the anchorages in covered stone canals, which are carried by huge pointed stone arches, and open spandrel walls. The arches serve also to render the towers more stable in the axis of the bridge.

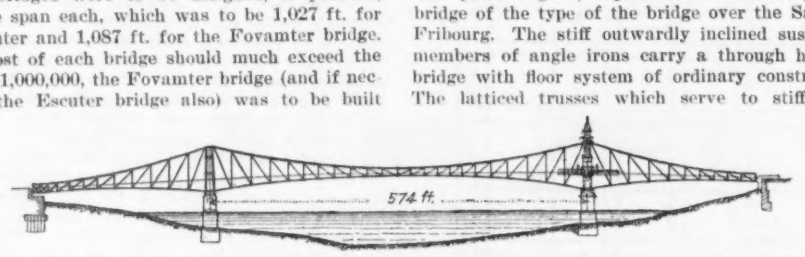


FIG. 2. SECOND PRIZE DESIGN; J. FEKETCHAZY AND STEINHARD & LANG.

FIG. 3. THIRD PRIZE DESIGN; RESCHITZA IRON WORKS.

Transversely the towers are connected by arches, thus forming portals. The house for ticket officers are built over the anchorages, forming pedestals for equestrian statues. The cost is estimated by the jury at $1,840,000, of which the metal construction would cost $745,000.

The second prize was given by a vote of 15 to 10 to a design for a three-span Fovamter bridge, Fig. 2. The authors are J. Feketchazy, ex-Chief Engineer of the Hungarian State Railways, and Architects Steinhard and Lang, of Budapest. The plan shows a cantilever bridge with top chords in graceful catenary lines. The bottom chords form flat arches underneath the floor foundation. The posts over the piers are decorated in iron. The cost would be $900,000, of which $256,000 would be for the iron construction.

The sum of $2,030, which could not be given to the first-prize design on account of its excessive cost, was unanimously awarded as a third prize to the design of the Reschitza Iron Works, with En-

* Abstracted from the "Zeitschrift des Oesterreich, Ing. und Arch. Vereines," by W. G. Triest, Jun. Am. Soc. C. E.

gineer Von Totth and Architect Schmal as authors. It is a plan for a cantilever bridge for Fovamter. The top chord is curved in pleasing catenaries, while the bottom chord follows the roadway.

Three other designs were bought for $1,000 each. Fig. 4 represents one of the latter. This received seven votes in the ballot for first prize, and is the plan of Chief Engineer Pfeuffer, of the Hungarian

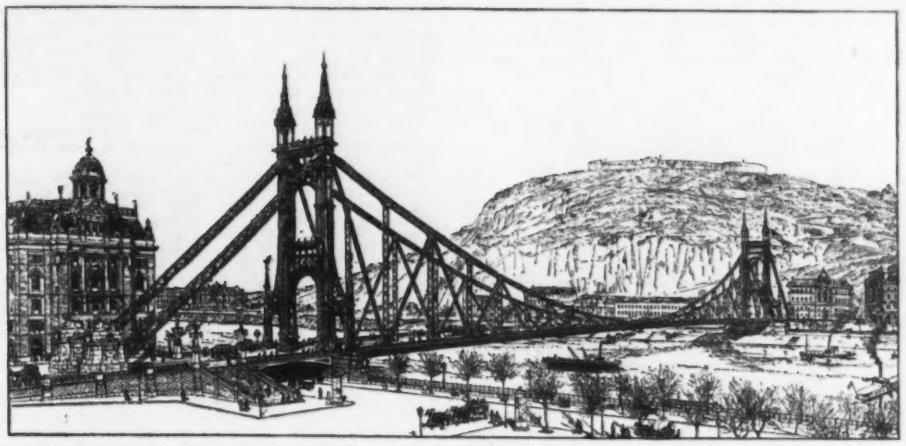


FIG. 4. PURCHASED DESIGN FOR ESKUTER BRIDGE.

State Railways, in co-operation with others. The design is for a pin-connected one-span bridge for Eskuter, the only representative of pin-connected bridges. The latticed, gracefully-curved top chord is stiffened by a web system of large panels. There are no top laterals and the truss has in the center only the depth of the railing, thus preserving an unobstructed view from the roadway and from the overhanging sidewalks. The top chords are carried over iron rocker columns, 130 ft. high, down to the anchorages, which are covered by masonry pedestals. The columns are connected transversely by iron lattice work, thus forming portals. The architecture of the latter is supposed to have been the reason that the design did not receive a prize. The cost of construction is given at $1,950,000.

One of the other purchased designs, by Rieppel and Tiersch, represents a cantilever bridge for one span, at Eskuter, of very original construction. It seems to consist of deep bow-string trusses, with suspended roadway, the top chords of which are carried from chains which lead over very ornamental stone towers to anchorages. In reality the ends of the bowstring girders form, with the chains above, brackets which are anchored by the chains. The supposed apexes of the bowstrings are suspended central girders.

The projects for the Fovamter bridge are mostly cantilever designs, with three openings, on the type of those above described.

Besides the large number of excellent designs, there are some which seemed to be intended only to furnish amusement to the jurors in their arduous work. One design for a one-span bridge at Eskuter shows curiously curved trusses, freely resting on abutments. The widely separated chords of the trusses are stiffened by enormous rings, and are ornamented by a legion of saints' statues. The wagon traffic moves over a suspended roadway, while the foot passengers climb over the bold curve of the top chord. Another fantastic design consisted of an iron tube of 1,020 ft. span, made up of Mannesmann tubes placed parallel and connected with each other by iron bars, riveted in spirals to the tubes.

Another competitor had the boldness to propose to span the whole width of the Danube with an extremely shallow brick arch. The arch is supposed to be built on a pontoon bridge and is floated between abutments of indefinite construction.

It must be said that the sum of mental work, as represented by the designs, is imposing, though, in spite of the co-operation of many eminent designers, no essentially new, epoch-making design was developed.

A factory building of steel skeleton construction is to be built at Providence, R. I., for the Burden Seamless Filled Wire Co. The architects are Hoppin, Read & Hoppin, of Providence, and the idea is to ensure abundant light.

RESULTS OF TIE PRESERVATION BY THE WELLHOUSE PROCESS.

The important advantages of preservative processes in increasing the life of ties, decreasing cost of track repairs and improving the character of the track, are gradually being recognized by railway managers. We are indebted to Mr. Octave Chanute, Past-President Am. Soc. C. E., for the following particulars of the results obtained from the Wellhouse zinc-tannin process of tie preservation.

Ties have been treated by this process by the Atchison, Topeka & Santa Fe Ry., at its own works at Las Vegas, N. M.; by the Union Pacific Ry., at its own works at Laramie, Wyo.; and by the Chicago Tie Preserving Co. (for the Chicago, Rock Island & Pacific Ry.) at Chicago, Ill. The numbers treated each year were as follows:

Year.	A., T. & S. F. Ry., Las Vegas. Mtn. pine.	U. P. Ry., C., Laramie. Mtn. pine & hemlock.	R. I. & P. Ry., Chicago. Hemlock & tamarack.
1885-86	261,607	140,580	148,823
1887	320,922	101,889	254,188
1888	201,096	....	209,734
1889	241,871	....	210,169
1890	98,353	....	253,267
1891	....	....	340,431
1892	....	....	325,736
1893	175,035	....	406,154
Total	1,298,884	242,469	2,148,502

At Las Vegas and at Laramie the treatment has been chiefly confined to mountain pine, which absorbs the solutions very well. At Chicago, hemlock and tamarack have been treated. These woods are somewhat more refractory because of their closer grain. The cost of treatment varies from 17 to 20 cts. per tie, according to size, amount of absorption, location, etc. This includes interest and repairs on plant.

In regard to durability, etc., the Atchison, Topeka & Santa Fe Ry. reports that its tie renewals have been largely reduced by the treatment. In 1880 it abandoned the zinc-tannin process and treated its ties by the Burnettizing process pure and simple, which is cheaper; but in 1893 it resumed the zinc-tannin process, and is operating it now. The Union Pacific Ry. stopped operating its works in 1887, for financial reasons, and has not resumed, the works having been partly destroyed by fire. On the Chicago, Rock Island & Pacific Ry. practically no ties treated by the zinc-tannin process were renewed until 1892, or after six years' service. In that year 2,319 were taken out, or 1.6% of the 148,823 laid in 1886. In 1893 there were 14,282 renewed, this amounting to, say, 1.6% on the 254,188 laid in 1887, and 7% on the number laid in 1886. This indicates that there were yet 91.4% of the latter ties in the track after seven years' exposure. The ties are materially hardened by the process, and are thought to resist cutting by the rail rather better than unprepared oak. Out of 50,200 oak ties laid by the Chicago, Rock Island & Pacific Ry. on new track west of the Missouri River in 1886, a total of 7,616 or 14.56% had been changed in 1893, while out of 21,850 treated hemlock ties, laid at the same time, and on the same sections, 692 or 3.16% had been changed in 1893.

Some difference is found in results in consequence of the exposure, the treated ties being reported to do best in clay upland soil. Burnettizing has been carried on in Europe for about 50 years, and some very excellent results have been accomplished with this process, although it is understood that there have been some complaints and the zinc chloride washed out of the wood in wet localities. This is said to have led to the more recent German practice of mixing creosote with the chloride of zinc, in order to repel moisture. Experience in the zinc-tannin process only dates back to 1881, when some ties experimentally treated were laid in the tracks of the Atchison, Topeka & Santa Fe Ry. at La Junta, Colo., and the following is the record of the latest examination, made on May 11, 1893:

Lot No.	Wood.	No. of ties.	Date laid.	No. now in track.	P. c. in track.	Time of exposure.
1	Black oak	49	May, 1882	47	96.0	11 years
2	W. cot'w'd	49	"	11	22.4	11 "
3	Cottonwood	50	"	22	44.0	11 "
9	Colo. pine	50	July, 1881	20	40.0	11.83 "

COMPARATIVE ADVANTAGES OF COLLARED AND COLLARLESS AXLES.

At the last quarterly meeting of the Southern and Southwestern Railway Club, a committee report was presented on the comparative advantages of collared and collarless axles for general rolling stock service. The first cost of forging collarless axles was stated to be somewhat less than of forging collared axles, as they were 1¼ ins. shorter and the working of the collar was omitted. The cost of the journal fittings is about the same. The price paid for labor and material materially influences the first cost. If the "Bissell" steel or iron wedge is applied, with bronze or brass filling, it will increase the cost of the collarless axle about $1.54 for each bearing; but in continuous service it would probably prove a good investment. However, excellent results could be obtained by adapting the M. C. B. standard lines for oil box, wedge, brass and axle, using the standard No. 4 blueprint, but omitting the collar on axle, and adding the end stops and also casting recesses in the inside of the box to receive the end stops. A well designed box and end stop could probably be constructed so as to dispense with the use of the wedge and obtain just as good results, if not better, thereby economizing and maintaining fewer parts.

Worn brasses on collarless journals can be withdrawn, and replacements made in much less time than is required to perform the same work on collared axles, especially when constructed without the use of the wedge. In designs where the brass or wedge is constructed with end shoulders, the view of journals and brass is obscured, which prevents inspectors from readily noticing diameter of journal and thickness of brass, and slight objections might possibly be raised in this direction. Where the end stop is used, however, the diameter of journal and thickness of brass can be noticed at a glance at all times, and it is apparent at once whether renewals of brass or axles are necessary, or what mileage can safely be relied on before renewals must be made. This is impossible with the collared axles.

The collarless axle is much the more durable. The most objectionable feature noticeable in the collared axle is the destructive end wear on collars and brasses. In some instances the highest mileage before renewal would not exceed 180,500 miles. There are records of collarless axles applied under passenger equipment, with journals 4¼×8 ins., which have run 200,000 miles. The journals were reduced only 5-32 in. in diameter, and in some cases less. There was occasionally one which was worn more at one end than at the other, probably due to some imperfection in the truck. Uneven journal wear may be attributed to misfitting dust guards or oil box lids, allowing sand and gritty substances to mix with the packing, and to inferior brasses. Close observation shows that with collarless journals, equipped with lead-lined brasses, with properly fitted dust guards and oil box lids, 2,300 miles can be obtained to 1 oz. of brass wear. The highest mileage obtained with collared axles, under exactly the same circumstances, would not go beyond 1,359 miles to 1 oz. of brass wear. The end wear on both collar and shoulder was most perceptible. The physical condition of the track is a great factor in the normal and abnormal wear of

the two kinds of journals. The collarless journal would not be of as much advantage on roads with comparatively straight track as on roads having sharp and abrupt curvature to contend with.

A building fitted with electric power for renting to light manufacturers is to be erected at Pittsburg, Pa., by Capt. J. J. Vandergrift, of that city. The building is to be 90 × 110 ft. and eight stories high, and will contain 64 rooms. In the basement will be a boiler, engine and dynamo plant, comprising three batteries of boilers and an engine driving a 250-HP. dynamo. The power will be conveyed from the dynamo to the motors scattered through the building by wires, and there will be no line shafting or belting of any character in the building. The cost of the building and machinery is estimated at $200,000 and the contract for its construction is reported let to Murphy & Hamilton, of Pittsburg, Pa.

The length of railway line in Mexico is 7,297 miles according to a recent report issued by the U. S. Department of Agriculture. The report also states that Mexican railways are suffering from the depreciation of silver, since the bonded debt and about one-third of the annual expenditure is payable in gold, while the earnings are all in silver dollars, which have also to be reduced to gold for remission abroad. Taking everything into consideration it is stated that about 8% per annum will fairly represent the ordinary increase of railway movement which can be counted on from year to year, and which is attributable to the general progress of the country and the development of its resources. Concerning the railway across the Isthmus of Tehauntepec from Coatzacoalcos, on the Gulf, to Salina Cruz, on the Pacific, the report states that about 20 miles at the center of the isthmus remain to be built. Work is now in progress on the harbor works at Coatzacoalcos, which will cost $4,300,000, and also on the large iron pier at Salina Cruz.

The condition of the Nicaragua Canal Co.'s property at Greytown has been found much better than was expected by U. S. Commissioner Hastings, who was sent by the government to inspect it, according to press dispatches from Greytown. It is stated that nearly all of the machinery can be made ready for use with no great repairs. The dredges were found in the poorest condition, and it is stated that many of them will need new hulls before they can be put in operation. The town of Greytown is stated to be practically deserted as a consequence of the stoppage of the canal work. Dispatches from Washington state that the unsettled details of the canal bill which will be reported to Congress have been practically settled. The committee will recommend a directorate of eleven members, eight government directors, one representative of the company, one from the government of Nicaragua and one from Costa Rica. Three government engineers will have charge of the work. It will be provided that dividends shall not exceed 5%, so that a sinking fund may be established. The government share of dividends will be credited to a sinking fund. Some members of the committee think the debt can be raised in 25 years on the lines laid down. Bonds were practically decided upon for the whole amount, as the proposition to coin silver involved troublesome complications and opposition. However, that section of the bill is left subject to change, so that if any plan involving the use of silver seems practicable it can be adopted.

A drawbridge with two center bearing spans is to be built at Columbus St., Cleveland, O. The ends of the draw spans will be in contact. Each span will be 134 ft. long, with a 20-ft. roadway and two 6-ft. sidewalks. The clear span will be 115 ft. between piers, and there will be a headway of 16 ft..

The comparison of English and American railways is a subject of perennial interest, and in England there is beginning to be a more intelligent understanding of American railways and railway practice. An English paper recently published an interview with Mr. C. E. Stretton (whose views on American railways were given in our issue of Aug. 24, 1893) in the course of which he stated that while on the whole railway traveling is probably safer in England, yet in many ways American railways are decidedly superior. For speed and comfort he thinks the latter stand first, but he believes that the visits of English engineers to Chicago last year will lead to important alterations and improvements in railway working in England. The improvement which Mr. Stretton is now specially urging upon railway companies is the introduction of sleeping cars for third-class passengers upon express trains, which cars would, in his opinion, not only prove a boon to the public but pay the railways handsomely.

The Nilgiri Railway, in India, has twelve miles laid with the Abt rack rail on grades as steep as 8% maximum. The line is meter gage, and there are two rack bars, carried in cast iron chairs fastened to the wooden ties by fang bolts. With the exception of the Pike's Peak Railway this is the only Abt rack railway using wooden ties, and full particulars of the method of construction adopted on the Pikes Peak road were sent to the engineers of the Nilgiri Railway by Mr. W. Hildenbrand, C. E., of New York, who represents the Abt rack system in the United States. The rack bars were made at Sheffield, England, and the steel was specified to have an ultimate tensile strength of 30 to 32 tons, with an elongation of 15 to 20% in ten miles. The bars are 12.6 ft. long, 4.4 ins. deep over the teeth and 0.88-in. thick. Every rack bar was required to be applied to a stud template having stops at the end representing the length, and projections of the exact sizes of the teeth and bolts.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BALTIMORE & LEHIGH.—It is reported that this road will be made standard gage. The line extends from Baltimore, Md., to York, Pa., 80 miles, and has been in the hands of receivers for some time.

PORTLAND & RUMFORD FALLS.—Edward Plummer, Lisbon Falls, Me., and H. J. Chisholm and G. C. Moses, Bath, Me., are said to be the chief promoters of a new company to be called the Swift River R. R. Co., which proposes to extend this railway 20 miles up Swift River into rich spruce timber regions in Maine. The route is said to have been surveyed twice and the construction will be commenced about July 1.

Projects and Surveys.

MONONGAHELA & ALLEGHENY.—Incorporated in Pennsylvania to build a railway from City Farm, on the Baltimore & Ohio, to the mouth of Negleys Run on south branch of Allegheny River, a distance of about six miles; capital stock, $60,000; Pres., Geo. T. Richards, Pittsburg, Pa.; directors, Jas. Doig, L. H. Partridge, Jas. Duncan, Jr., Wm. Smith, C. H. Sackrider, R. S. Feaser, Pittsburg, Pa.

PENINSULA.—Organized to consolidate the Baltimore & Delaware Bay, Easton & Chestertown, and Elkton & Southern railways. It is stated that the Elkton & Southern is to connect with the Baltimore & Ohio at Childs station, and connect at Lambson's station with the Baltimore & Delaware Bay, which will be rebuilt, and which will be made to extend to Tolchester and from thence to Chestertown, where it will connect with the Chestertown & Easton, thus forming a trunk line down the Maryland peninsula. Extensive improvements will also be made at Bombay Hook, where the cars are to be transferred to the Jersey Central. Traffic arrangements have been made with the Baltimore & Ohio and with the Jersey Central which will give a large coal traffic to the new road. The surveyors will soon have finished their labors and report a permanent route. The Elkton & Southern has elected the following officers: Pres., George Biddle, Cecilton, Md.; Treas., Emil Thieleus, Philadelphia; Secy., Dr. Howard Bratton, Elkton, Md.

WADDINGTON & HIGH FALLS.—The Buffalo "Courier" states as follows: Surveys are now being completed for a new railway 25 miles in length, to be known as the Waddington & High Falls, connecting with the Rome, Watertown & Ogdensburg at High Falls, N. Y. Deep cuts will be encountered between Waddington and Madrid, Madrid and Canton, and between Canton and High Falls. There will be stations at Dry Island, near Waddington; at Joyce's Road; at Madrid village; at Madrid Springs, where the road will cross the O. & L. C.; at Bucks Bridge; at Canton village, where the road will cross the R., W. & O., and at High Falls, the present terminal point. A 100-ft. iron bridge will be required at Brandy Creek, near Waddington; a 260-ft. bridge across the Grass at Bucks Bridge village, besides bridges across Little River at Canton and across the Grass at High Falls. Pushing the work of the final survey is an engineer corps of over 20 men, in charge of John G. Talt, Res. Engr., with C. F. Parker in charge in the field, the whole engineering corps being under the direction of Maj. Geo. B. Burbank, of Niagara Falls fame. The railway company, so the promoters claim, will be entirely distinct from the St. Lawrence River Power Co., and at present has no connection with any other road. The road will be laid with 90-lb. steel rails. It is intended to equip it with one passenger and two freight locomotives, two baggage-cars, five coaches and 50 freight cars. The estimated cost of constructing and equipping this proposed line is $500,000.

Southern—Projects and Surveys.

PANTHER FORK.—A. H. Winchester, Buchannon, W. Va., writes us that this is a projected logging railway owned by the Buchannon River Lumber Co., but that the construction has been indefinitely postponed owing to the dull times.

TAVARES, ATLANTIC & TAMPA BAY.—It is stated that the construction of this railway will soon be commenced by W. E. Simmons, contractor, Tavares, Fla.

Northwest—Existing Roads.

CHICAGO & NORTHWESTERN.—A press report from Shawano, Wis., states as follows: A party of Chicago & Northwestern engineers, numbering 17, from Kaukauna, Wis., in charge of Hiram J. Sliper, were in the city June 18, leaving for the north by way of Keshena, and are engaged in surveying and locating a branch of the Northwestern from Shawano north to intersect the Watermeet and Power branch of the North western line.

ELGIN, JOLIET & EASTERN.—Press reports state that this railway, the Outer Belt Line, has perfected arrangements to enter the city of Chicago over the tracks of the Monon from Dyer, Ind., and thence over the Western Indiana to the Dearborn St. station. The present owners of the road are represented by Drexel, Morgan & Co., New York, and it is said the syndicate will erect an extensive system of elevators near the South Chicago docks, to reach which it will be necessary for the new road to build three miles from a point on the line of the Western Indiana. The Elgin, Joliet & Eastern was originally built to facilitate the handling of freight originating at Elgin, intermediate points and Joliet. The road crosses every important trunk line leading to and from Chicago. Dearborn station is the Chicago terminus of the Wabash system.

FREMONT, ELKHORN & MISSOURI VALLEY.—It is stated that the contract for the first 20 miles of the extension to the Hay Creek coalfields, noted last week, has been awarded to C. D. Crouch and that the tie contract has been awarded to Daniel Ferguson, Deadwood, S. Dak.

Projects and Surveys.

FORT HARRISON.—The contract for constructing a branch railway at Fort Harrison, near Helena, Mont., has been awarded to Hugh Kirkendall, Helena, at $8,590, the other bids being: Green & Quinn, Helena, $9,662; John Brady, Helena, $9,881; A. D. Guy, Helena, $10,109; Thos. L. Greenough, Missoula, Mont., $10,361; Fred. Youngen, Minneapolis, Minn., $10,950.

Southwest—Existing Roads.

ST. LOUIS & SAN FRANCISCO.—It is stated that surveys are being made for an extension from Sapulpa, Ind. T., southwest to Guthrie, Okla.

SOUTHERN PACIFIC.—Press reports state that an engineering corps under the supervision of E. B. Cushing, Resl. Engr., Houston, Tex., are now engaged in surveying the line of the proposed extension of the branch from St. Martinsville, La., to Arnaudville, and that it is expected by the officers of the company that the work of construction on the new extension will begin as soon as the right of way and line survey is completed and submitted to the company, so as to be finished in time to handle the growing crop. The site for the depot has been located at Arnaudville, and everything points to a quick and favorable execution of the enterprise.

Rocky Mt. & Pacific—Projects and Surveys.

DENVER & WESTERN.—Incorporated at Denver, Colo., to build a mining railway with several branches from Alice, on Silver Creek, Clear Creek county, to Central, Black Hawk, Denver and the northern boundary line of Colorado; capital stock, $1,000,000; directors, Henry Paul, Denever; J. W. Hawk, Wm. M. Mitchell, Topeka, Kan.; Edward W. Williams, and Wm. O. McFarlane. The main line will be about 12 miles in length, the surveys for which are nearly completed. This is a plan to open the new mining camp of Yankee Hill.

MONTEREY & FRESNO.—It is stated that a general contract for constructing this railway from Monterey to Fresno, Cal., 170 miles, has been awarded and that the grading will be commenced July 4. The project was described in our issue of May 17. Ch. Engr., P. P. Dandridge, Monterey, Cal.

POTRERO & BAY VIEW.—Incorporated in California to build a railway about four miles in length to the Bay View racecourse or to Hunter's Point; capital stock, $500,000; directors, H. F. Williams, W. F. Williamson, Elijah Case, J. W. Pierson, John Kilpatrick, C. N. Felton and J. C. Birdseye.

STREET AND ELECTRIC RAILWAYS.

SKOWHEGAN, ME.—Arrangements are being made by A. F. Gerald, Fairfield, and J. C. Libby, Waterville, to construct an electric railway from this place to Norridgewock. The Worcester Construction Co. offers to build and equip the road for $45,000, according to reports.

BROOKLYN, N. Y.—The Nassau Electric R. R. Co. has awarded a contract to the Berlin Bridge Co. to erect a 157 × 106-ft. power house, at $50,000.

NEW YORK, N. Y.—The Metropolitan Traction Co. has petitioned for a franchise for a cable road in 23d St., from Broadway to Lexington Ave.

TROY, N. Y.—About one-half of the $50.000 asked by the Troy & New England R. R. Co., as a bonus for constructing an electric line to Sand Lake, has been subscribed.

AMBLER, PA.—The Ambler Electric Ry. Co. has been incorporated to build a road about two miles in length; capital stock, $12,000; incorporators, J. W. Shepp, D. B. Shepp, E. A. Murphy, Philadelphia; W. B. Krick, Reading.

FOREST CITY, PA.—It is reported that L. P. Wedeman and W. J. Maxey, of this city, are endeavoring to organize a corporation to build an electric railway from Dundaff to Nicholson.

HAGERSTOWN, MD.—W. A. Sheldon, Man. General Electric Trust, Cincinnati, O., is reported as trying to secure a franchise for an electric railway in this city.

NEW ORLEANS, LA.—The St. Charles St. R. R. Co. has petitioned the council for a franchise to operate its line by electricity.

JACKSON, TENN.—It is reported that a company is being formed to build an electric railway.

CLEVELAND, O.—The Cleveland & Elyria Ry. Co. has been incorporated to build an electric railway between the places named; capital stock, $100,000; incorporators, B. F. Phinney, Jay Comstock, J. M. Gasser, H. D. Coffinberry and Dallas Bebe.

WEST RICHFIELD, O.—M. E. Porter writes us that a company has been incorporated to build an electric railway from Cleveland to Akron, passing through the townships of Breeksville and Richfield, a distance of 28 miles. Mr. Ritchie, Cleveland, has made surveys. A bonus of about $40,000 has been raised.

WORTHINGTON, O.—The Worthington & Westerville Electric St. Ry. Co. has been incorporated.

ELKHART, IND.—The Indiana Electric Co. has acquired the plant of the Elkhart street railway, and Goshen and this place will be connected by an electric line, according to reports.

NORTH GREENFIELD, WIS.—The Milwaukee St. Ry. Co. has been granted a franchise to build an electric railway from the National Park to the State Park.

STILLWATER, MINN.—The Stillwater Electric Ry. Co. has been organized, with a capital stock of $75,000; Pres., Allen Curtis, Boston, Mass.; Treas., E. P. Motley, Boston; Secy., J. C. Nethaway, Stillwater.

KANSAS CITY, KAN.—The Kansas City Electric St. Ry. Co. has been incorporated; capital stock, $1,000,000; directors, J. H. Parrott, R. A. Kope, P. F. Spickler, Kansas City, Kan.; E. L. Luggrew, Ozone Park, N. Y.; Lewis Hammel, West Chester, Pa.

CORSICANA, TEX.—The Corsicana street railway property including about four miles of track, has been sold to R. B. Moffett, Waxahachie, who will at once

put the road in good condition and begin its operation, according to reports.

HIGHWAYS.

TENNESSEE.—A committee has been appointed at Nashville to investigate the question of improving the roads in Davidson county. C. A. Sharenberger, Chn.

ARKANSAS.—The contract for macadamizing the Fourche Dam road in Pulaski county has been awarded to Bragg & Downes, Little Rock, at $17,592.

COLORADO.—The Flowers Toll Road Co. has been incorporated at Denver by Jacob Flowers, W. L. Clayton and B. F. Flowers, to build a road in Larimer county; capital stock, $20,000.——It is reported that it is proposed to construct a road from Glenwood Springs, Garfield county, to the summit of Lookout mountain.

WASHINGTON.—The commissioners of King county have awarded the contract for 5,236 ft. of macadamizing to James McCallum, Seattle, at 86 cts. per lin. ft.

BRIDGES AND TUNNELS.

HOLYOKE, MASS.—The city engineer has completed plans for a stone and brick bridge on Cabot St., estimated to cost $25,000.

BROOKLYN, N. Y.—At a public hearing in the Army Building, New York, last week, Col. G. H. Gillespie, U. S. Engr., and others advocated the rebuilding of the bridge over Newton Creek at once. The opinions were forwarded to the Secretary of War.

WILLIAMSPORT, PA.—The county commissioners awarded contracts last week for rebuilding four bridges swept away by the recent high water, and bids are asked until June 28 for rebuilding the Market St. bridge, 5 spans, in this city. The Muncy bridge was five spans (941 ft.), and will cost $23,950. The same bridge cost in 1889, without advertising for bids, $39,500. The Jersey Shore bridge, 3 spans, will cost $15,450, and was originally purchased at $32,500. The Perryville bridge that was built in 1880 cost $7,987 and the Fields bridge $2,185. These have each one span, and will be built of material of the bridge washed away from Market St., at a cost of $4,185 for both. The other bids for this work are based on new material. The contracts for the stone work for the five bridges were awarded to Smith & Campion, Mahanoy City, without advertising, as the commissioners are reported as being convinced that better work would be secured by avoiding competition. Webb & Perkins, the engineers in charge of the construction of the susperstructure of these bridges, inform us that the bids were as follows:

	Muncy.	Jersey Shore.	Perryville and Fields.
Horseheads(N.Y.)Brdg Co.	*$23,950	$16,500	$10,525
Dean & Westbrook	23,700	16,300	.....
Nelson & Buchanan**	24,220	16,250	10,050
King Bridge Co.	24,700	16,900	.....
Groton (N. Y.) Bridge Co.	21,100	16,000	10,700
Massillon Bridge Co.	24,960	.....	.....
Varity Iron Co.	24,890	17,800	10,470
Berlin Bridge Co.	25,600	16,400	12,000
Champion Bridge Co.	28,000	16,610	12,000
Wrought Iron Bridge Co.	25,990	17,620	12,220
Columbus Bridge Co.	27,637	16,450	11,011
Phoenix Bridge Co.	24,300	16,480	11,300
Owego (N. Y.) Bridge Co.	24,500	*15,450	10,050
E. Keller & Co.***	.....	.....	*4,185

* Awarded contract.
** Chambersburg, Pa.
*** Williamsport, Pa.

ELKTON, MD.—The county commissioners have contracted with the Groton Bridge Co., Groton, N. Y., for seven bridges, to cost $13,500.

WILLIAMSPORT, MD.—A company is reported as being organized at this place, six miles from Hagerstown, to build a bridge over the Potomac River; capital stock, $35,000.

MONTGOMERY, ALA.—It is stated that a company is being organized in this city to build a $150,000 steel drawbridge over the Alabama River.

ASHTABULA, O.—The proposition to issue $30,000 in bonds to secure the construction of a highway bridge across the gulch, estimated to cost $87,000, was defeated last week by 17 votes.

ALBION, MICH.—Bids are asked until July 2 for two steel and one stone bridge, as stated in our advertising columns. F. Laberteaux, Cy. Engr.

WICHITA, KAN.—Press reports state that a Rock Island railway bridge at Round Pond Creek was destroyed by dynamite June 22.

YANKTON, S. DAK.—The plans for the proposed railway and wagon bridge across the Missouri River have been received by Senator Pettigrew, according to press reports, and will soon be submitted to the Secretary of War for approval; estimated cost, $45,000.

VAN BUREN, ARK.—The Van Buren-Arkansas Bridge Co. has been incorporated to construct a railway and highway bridge across the Arkansas River at this place; capital stock, $150,000; Pres., H. C. Meechem.

SEYMOUR, TEX.—The county commissioners are reported as about to order an 80-ft. iron bridge to replace a trustle over the Brazos River, recently washed out.

MARIETTA, IND. T.—Bids are asked at once for building a 60 to 70-ft. span wooden bridge. S. S. Evarts.

MONTREAL, QUE.—The Montreal Bridge Co., has petitioned the city council to grant $40,000 a year for 20 years to the company to assist it in constructing a proposed $5,000,000 railway and highway bridge across the St. Lawrence River, from St. Mary's Ward across Isle Ronde to the south side of the river. Pres., Henry Hogan; Vice-Pres., J. R. Thibaudeau; Director, A. T. Gault; Secy.-Treas., Robert Watson.

OTTAWA, ONT.—Press reports state that a large deputation from Ottawa and Hull waited on the government June 19 to ask for a bonus of $250,000 towards the construction of an interprovincial bridge across the Ottawa River, at this place. This city has voted $150,000 in subsidy and the government is said to have given a favorable reply.

WINNIPEG, MAN.—Bids are asked until July 12 for the construction and erection of an iron or wooden superstructure for the Maryland St. bridge. The bids recently received for this work were published in our issue of May 31. J. C. Sproule, Chn. Com. H. N. Ruttan, Cy. Engr.

WATER-WORKS.

LEWISTON, ME.—The council is discussing the advisability of increasing the supply; estimated cost of extra pumps, $10,000.

PITTSFIELD, ME.—At an election June 14 it was voted to appoint a committee to contract with the Pittsfield Water Co. for a supply.

ASHLAND, N. H.—Chas. H. Bartlett, Manchester, is reported as about to superintend the construction of works.

NEWMARKET, N. H.—It is reported that a committee has been appointed to contract for about 50 hydrants, at an annual rental of $2,000.

LUDLOW, VT.—It is stated that the town is in favor of putting in works; estimated cost, $20,000.

UNDERHILL, VT.—T. W. Thorp is to put in works, including a reservoir, for fire protection, according to reports.

MONSON, MASS.—Plans and specifications for works are nearly completed and it is stated that bids will soon be asked.

PROVIDENCE, R. I.—As related at length elsewhere in this issue, it is probable that a system of filter beds will be constructed for the purification of the city's water supply, instead of mechanical filters, owing to a recent court decision. It is stated that Everson & Liddle, local contractors, stand ready to build filter beds with a daily capacity of 15,000,000 gallons for $200,000, the beds to be constructed after plans to be furnished by J. Herbert Shedd, Cy. Engr. The council will investigate the matter.

NEW LONDON, CONN.—The city has sold $60,000 of water bonds to R. L. Day & Co., Boston, for $63,113.

UNIONVILLE, N. Y.—The Unionville Water-Works Co. has been incorporated to construct works; capital stock, $25,000; Wm. McMurtrie, Brooklyn; Wm. M. Smith, Newtown; Alvin J. Grathn, New York, and others.

BUFFALO, N. Y.—The council has appropriated $19,000 for improvements at the pumping station.

PHOENIX, N. Y.—The plant of the Phoenix Water Co. is reported to have been sold at public auction to Orrin F. Gaylord, Oswego, for $7,000.

DANSVILLE, N. Y.—Bids are asked for constructing works for domestic use. The village has a gravity system for fire protection, costing $30,000. Chas. A. Snyder, Pres.

EDWARDS, N. Y.—Bids are asked until July 12 for constructing works. D. M. Taylor, Pres., Bd. Comrs.

LOWVILLE, N. Y.—The contract for constructing works has been awarded to L. J. Richardson and E. S. Ferris, of Watertown, at $20,648. The total bids were published last week.

TROY, N. Y.—Bids are asked until June 29 for two horizontal return tubular boilers of 175-HP. each. Geo. B. Fales, Clk. Comrs.

CAMDEN, N. J.—It is stated that work will be commenced this week on four artesian wells to be sunk as an experiment for an improved supply.

FLEMINGTON, N. J.—The Flemington Water Co. is reported as about to make extensive improvements.

GLASSBORO, N. J.—It is stated that work on the plant for this place and Clayton will be commenced by the American Pipe Co., Philadelphia, as soon as the location is decided upon.

PEMBERTON, N. J.—The Pemberton Township Water Co. has been incorporated with a capital stock of $10,000; directors, Theo. Budd, Aaron Early, A. J. Morris and others. Surveys are being made and it is stated that a 60,000-gallon cedar tank will be constructed.

EDDYSTONE, PA.—The borough is negotiating with the Springfield Water Co. for a supply.

NORTHUMBERLAND, PA.—Bids are asked until July 14 for constructing works for the Northumberland Water Co., as stated in our advertising columns.

RANKIN, PA.—It is stated that $20,000 of bonds have been voted for works; supply from Braddock or Allegheny Water Co.——Plans have been prepared by Trimble & Miller, Pittsburg, and bids will be asked within a few days for the construction.

WARREN, PA.—The Warren Water Co. is arranging to secure a new supply four miles beyond the present supply.

CULPEPER, VA.—W. J. Shotwell, Town Recdr., writes us that the citizens have voted, 195 to 5, in favor of issuing $20,000 in bonds for works, but that no steps have yet been taken for plans.

GRAFTON, W. VA.—Bids are asked until July 16 for constructing works, as stated in our advertising columns. Engrs., Wilkins & Davison, Pittsburg. B. F. Bailey, Secy. Comrs.

WINSTON, N. C.—The aldermen have called an election for Aug. 7 to vote on issuing bonds for $100,000 for purchasing works and extending the same.

CUTHBERT, GA.—Plans are being considered for works and an electric light plant, according to reports, and it is expected that the construction will soon be commenced.

CRESCENT CITY, FLA.—G. H. Williams, Town Clk., writes us that the town is negotiating with Miller & Cash for a supply for fire protection. An iron tower and wooden tank have already been erected and iron pipe, hydrants, etc., will also be required; supply from artesian wells.

MADISON, FLA.—Col. J. F. Le Baron, Jacksonville, has completed plans for works estimated to cost $16,000. Bonds have been sold and the contract will soon be let for the construction. Work will include 201 tons of 12 to 4-in. pipe, 31 hydrants and a 25 × 30-ft. iron tank upon a steel trestle 80 ft. high.

COLUMBIA, ALA.—J. E. Searcy, Clk., writes us that the contract for works has been awarded.

THIBODEAUX, LA.—The citizens have voted in favor of a five-mill tax for ten years for works.

KNOXVILLE, TENN.—The Lonsdale Bloumont Water Co. has petitioned for a franchise for North Knoxville, offering to furnish a supply at 20% less than the present rate.

NASHVILLE, TENN.—The penitentiary commission has awarded the contract for the pump-house and reservoirs to Burke & Edmonds, Bridgeport, Tenn., and that for pump and piping to Mooney & Baine, Nashville.

SPRINGFIELD, TENN.—Steps are being taken for works, according to reports.

SHELBYVILLE, KY.—The Court of Appeals has approved the contract between the city and the Shelbyville Water & Electric Light Co., by which the city is to pay $4,500 per year for 13⅓ years, and it is expected that the works will be constructed as soon as possible.

ASHLAND, O.—An election will be held July 7 to vote on an issue of $45,000 in bonds for works.

ATTICA, O.—The water-works proposition carried at the special election, by a vote of 136 to 17.

CAREY, O.—Bids are about to be asked for constructing works, according to reports. Engr., Jarvis S. Humphrey, Findlay. J. A. Gibbs, Secy. Trustees.

NAPOLEON, O.—Bids are asked until July 24 for constructing works and an electric light plant, as stated in our advertising columns. Engr., J. B. Strawn, Salem. Josiah Koller, Secy. Bd.

ST. BERNARD, O.—George Hornung, Consult. Engr., Cincinnati, writes us that the following bids were received June 19 for the power station of the water-works and electric light plant:

Pat. Murray & Son, Cincinnati, O.	$17,188
T. A. McLain & Son, Linwood, O.	16,992
J. Geiswein & Bro., Hartwell, O.	16,364
A. L. Tosso, Carthage, O. (awarded contract).	16,000

TOLEDO, O.—Bids are asked until July 10 for constructing a water-tower for the state hospital. Arch., E. O. Fallis, Nasby Bldg. H. A. Tobey, Secy. Bd.

ALEXANDRIA, IND.—The Alexandria Water Co. was incorporated June 20 with a capital stock of $60,000.

CAMBRIDGE CITY, IND.—The question of works is being agitated.

HOWELL, IND.—It is stated that the proposed extension of the mains from Evansville to this place is estimated to cost $4,437.

FORT WAYNE, IND.—The South Wayne residents are reported to have voted to issue $13,000 in bonds for works.

SOUTH BEND, IND.—Plans are being considered for securing an additional supply.

CHESANING, MICH.—The committee is reported as in favor of works and electric lights, and the council is expected to take action in favor of the improvements this week.

DETROIT, MICH.—The commissioners have decided in favor of extensions estimated to cost $50,000 to increase the supply for the fire department.

AURORA, ILL.—The council is considering an appropriation of $30,000 for extensions.

JOLIET, ILL.—Frank W. Dewey, Supt., writes us that the city will add a 3,000,000-gallon Pohle air-lift pump this summer and will make about a mile of extensions; contracts not yet awarded.

KIRKWOOD, ILL.—Bids are asked until July 12 for pipe, hydrants, stand-pipe, pumping machinery, etc., as stated in our advertising columns. Consult. Engr., Chas. F. Sturtevant, St. Louis. C. H. Mundorff, Pres. Trustees.

LEXINGTON, ILL.—The council is investigating the question of works; estimated cost, $12,000.

MILAN, ILL.—The contract for sinking an artesian well, as the first step for works, has been awarded to J. P. Miller & Co., Chicago, at $1.70 per ft.

MORRIS, ILL.—Voorhees & Wittmer, Buffalo, have been engaged to prepare plans and specifications for works and to superintend the construction.

RANTOUL, ILL.—The contract for a boiler for the works has been awarded to Maltby & Wallace, Champaign, and that for sinking the well, etc., to J. A. Mounts, Delavan.

SIDELL, ILL.—The citizens want works, according to reports.

WHEATON, ILL.—The contract for the stand-pipe for the new works has been awarded to Brownell & Co., Dayton, O. Engr., W. S. Shields, Title & Trust Bldg., Chicago.

KAUKAUNA, WIS.—Bids are asked until July 17 for a franchise for works, the city to contract for 90 hydrants, as stated in our advertising columns. H. B. Tanner, Mayor.

KENOSHA, WIS.—The council has granted a franchise to I. W. Newcomer, Chicago, who is reported as planning to construct works to cost $125,000.

ESTHERVILLE, IA.—N. B. Egbert, Cy. Clk., writes us that the city has voted in favor of works and an electric light plant and that bids will be asked as soon as possible for the construction.

MASON CITY, IA.—J. B. Clow & Son, Chicago, have been awarded a contract for pipe for proposed extensions in the northern part of the city.

SIOUX CITY, IA.—The committee has recommended that a separate plant be put in to supply Morning Side; supply from wells.

TRAER, IA.—The proposed tax for works was carried almost unanimously and a $10,000 plant will probably be put in at once.

CROOKSTON, MINN.—The council has directed the committee to ascertain the cost of securing an artesian supply.

MARSHALL, MINN.—It is stated that an election will be held July 3 to vote on an issue of $25,000 in bonds for works.

SPRINGFIELD, MINN.—The arrangements for putting in works and an electric light plant are reported as about completed.

BANCROFT, NEB.—The citizens voted June 18 to issue $7,000 in bonds for works, but it has been since learned that the law permits the village to vote only $5,300.

CEDAR RAPIDS, NEB.—The $9,000 in water bonds have been sold, and it is stated that bids will be received at once for the construction.

FLANDREAU, S. DAK.—We are informed that the city has commenced the construction of a $10,000 system.

GRAND FORKS, N. DAK.—The council has voted to bond the city for $40,000 for extensions and for a filter plant.

WESSINGTON SPRINGS, S. DAK.—It is stated that works will be put in by the township company.

GLASGOW, MO.—Bids are asked until July 7 for constructing works. Engr., F. Wm. Reader, St. Louis. H. Clay Cockerill, Cy. Secy.

HOUSTON, TEX.—W. J. Buck and others, of Mobile, Ala., have petitioned for a franchise, offering the city 400 hydrants at $40 each per year and all additional at $30 each.

MARBLE FALLS, TEX.—W. H. Badger, Secy. Ice, Light & Water Co., writes us that all materials for the new works have been purchased except a few thousand feet of pipe.

MINERAL WELLS, TEX.—J. T. Harris writes us that the contract for works has been awarded to O. J. Gorman & Co., Dallas.

ROCK SPRINGS, TEX.—The Rock Springs Water Supply Co. has sold its plant to J. M. Haney, who is reported as about to make improvements and extensions.

BALLARD, WASH.—An artesian supply has been secured and it is stated that the question of issuing bonds for works is again being agitated.

EVERETT, WASH.—The Everett Water Co. has been granted a franchise for the streets not already held by the company.

SAN DIEGO, CAL.—E. M. Clapp, Cy. Engr., and others are investigating the question of municipal works, for which it is proposed to appropriate $1,500,000 or more.

CAMPBELLTON, N. B.—The Campbellton Water Co. has been incorporated by J. R. Thibedeau, Alfred Rinfret, Alfred Roy and Raoul Rinfret, C. E., all of Montreal; capital stock, $60,000.

ARTESIAN WELLS.

ASHLAND, WIS.—Bids are asked until July 3 for drilling a well in Mount Hope Cemetery. Thos. Telford, Cy. Clk.

OAK CLIFF, TEX.—Bids are asked for boring an artesian well for the Oak Cliff Water Supply Co. G. R. Carlton, Supt.

ROCKY FORD, COLO.—Press reports state that the citizens have accepted a proposition of J. W. Poponoe, Denver, to bore a well 800 ft. deep.

IRRIGATION.

DOUGLAS, WYO.—The ditch enterprise at this place under contemplation by Messrs. Richards and Shoenfelt is stated in a press report as comprising a rock dam across the Platte River at a point near the mouth of the Wagon Mound and a waterwheel capable of producing at least 500 HP. This will run pumps with which the water will be raised 25 ft. and carried thence in a ditch 30 ft. wide to the adjacent lands. Preliminary surveys show that 10,000 acres of land can be brought under the ditch, all on the north side of the river.

O'NEIL, NEB.—It is stated that the contract was let June 21 for the construction of an irrigation ditch south of the Elkhorn River by the Elkhorn Irrigation Co., and that work will begin in a few days. The contract provides for the completion of the ditch by Nov. 1, 1894. The proposed ditch will be 12½ miles long. It takes the water out of the Elkhorn River, ten miles west of O'Neil, and conducts it south of the river to a point on Dry Creek, four miles south of O'Neil. It will irrigate over 90,000 acres.

DENVER, COLO.—John M. Kincaid is expected to commence work this week on the Boss Lake reservoir, at the headwaters of the South Arkansas River, in Chaffee county; estimated cost, $11,000.

LINDA VISTA, CAL.—Bids are asked until July 3 for the purchase of $10,000 of the bonds of the Linda Vista Irrigation district. Geo. K. Phillips, Secy.

ESCONDIDO, CAL.—The final contract for the sale of the $250,000 in bonds of the Escondido Irrigation district and for the construction of the entire system is said to have been closed June 12. The bids were published in our issue of March 29.

SANTA FE, N. MEX.—A press report states that through the recommendation of Lieut. Plummer, agent, in charge of the Navajos, Governor Thornton and General McCook have, for some time, been urging upon the Interior Department and Congress the importance of providing an efficient irrigating system for the Navajos' reservation. About a year ago Congress made an appropriation of $60,000 for this purpose, and during the last summer Lieutenant Brown, Engr., assisted by Frank J. Coolidge, of San Juan county, surveyed the northern part of the reservation, and concluded that a good ditch could be taken out at Chaco Canyon, and another at a point on the San Juan River, a mile below Farmington. Nothing further was done until last month, when E. C. Vincent arrived at Fort Defiance with an appointment as superintendent of irrigation on the Navajo reservation. Since then he has been busy preparing to build the proposed ditches, and will begin active work as soon as teams and scrapers can be purchased. Indian labor will be utilized as far as possible.

NEW COMPANIES.—Windy Spring Irrigation Co., Lakeview, Ore.; $2,000; James and W. J. McKee, J. S. Lane.——Headley Irrigation Co., Walla Walla, Wash.; $600; C. P. Headley, P. P. Pearson, W. Riser.——Veck Irrigation Co., San Angelo, Tex.; $10,000; S. E. Sterrett, G. B. Sherwood, A. B. Sherwood.——Fremont Canal & Power Co., Fremont, Neb.; $1,500,000.——Riverside Canal & Irrigation Co., Culbertson, Neb.; $10,000.——Laurel Street Lateral Ditch Co., Fort Collins, Colo.; $1,000.

SEWERS.

LANCASTER, N. H.—It is reported that the construction of sewers, for which $25,000 was appropriated last March, will be commenced as soon as the ground freezes in the fall, so as to avoid the quicksand in three of the streets.

ROCHESTER, N. H.—The council is discussing an appropriation of $30,000 to $50,000 for completing the system.

ENOSBURG FALLS, VT.—W. W. Hutchinson, Town Clk., writes us that surveys are being made for a system, but that no appropriation has yet been voted for the construction.

AMHERST, MASS.—The selectmen are considering plans for sewers in the eastern part of the town.

BELMONT, MASS.—A town meeting has been held to discuss the construction of a main sewer or of a complete system.

GARDNER, MASS.—F. L. Allen, Worcester, has been awarded the contract for constructing sewers in four streets, at $12,487, the other bids being as follows: McCusker Bros., Waltham, $15,656; Jos. Moreau, Gardner, $15,944; G. M. Atkins & Co., Palmer, $16,796.

NEW BEDFORD, MASS.—A. B. Drake, Supt. Pub. Wks., has estimated the cost of completing the Bonney St. brick sewer at $40,968, and an appropriation of $20,000 for extending the sewer is being discussed.

VALLEY FALLS, R. I.—The council is considering plans for constructing sewers, according to reports. Engr., L. C. Heywood, Pawtucket.

NAUGATUCK, CONN.—A system is being discussed.

BATH-ON-HUDSON, N. Y.—Bids are asked until July 2 for constructing 8-in. pipe sewers in two streets. T. G. Wornham, Village Clk.

BELMONT, N. Y.—It is reported that Leander Gorton has made surveys for a system. About 4,000 ft. of pipe will be required on the south side.

BUFFALO, N. Y.—Bids are asked until July 10 and 12 for constructing 20 to 10-in. pipe sewers in several streets. B. G. Parsons, Acting Secy. Dept. Pub. Wks.

CHATEAUGAY, N. Y.—Levi Leake is interested in a company that has been granted a franchise for a system.

LYONS, N. Y.—The board of public works has been petitioned to construct a proposed outlet sewer into Clyde River, instead of Black Brook, as now planned.

NEW YORK, N. Y.—The board of public works has received the following bids for constructing a sewer in 23d St.: Steward & McDermott, $51,497; F. Thiemann, Jr., $52,914; W. F. Cunningham, $49,555; Patrick Casey, $48,240; B. Mahon, $60,077.——Bids are asked by the department of public works until July 10 for constructing a sewer in 117th St.

JERSEY CITY, N. J.—The officials of this city and Hoboken are considering plans for reconstructing the Ravine Road sewer, which is estimated to cost about $80,000.

BLOOMFIELD, N. J.—Bids are asked until June 30 for constructing three lateral sewers. Bonds will be issued to cover the cost. W. L. Johnson, Township Clk.

BRADFORD, PA.—Bids are asked until July 2 for constructing 4,912 ft. of 12 to 8-in. pipe sewers. P. B. Winfree, Cy. Engr.

CHESTER, PA.—Bids are asked by the committee for constructing sewers in two streets.

EMPORIUM, PA.—A. H. Shaffer, Engr., writes us that 30 and 24-in. pipe sewers, estimated to cost $5,000, will be constructed by day labor.

GREENSBURG, PA.—Bids are asked until July 2 for constructing sewers in Ward 5. A. G. Marsh, Town Clk.

MOUNT PLEASANT, PA.—Engineers are making plans for sewers, and it is stated that bids will be asked by the council as soon as the plans are completed.

NORRISTOWN, PA.—W. D. Patterson, Heed Bldg., Philadelphia, has been engaged to make surveys for a complete system. The separate system will probably be used.

WILLIAMSPORT, PA.—Bids are asked until July 6 for constructing 2,050 ft. of brick sewer, as stated in our advertising columns. Wm. J. Dreisbach, Cy. Clk.

PORTSMOUTH, VA.—The lowest bid received for constructing the proposed system was that of D. L. Wardorfer, Gainesville, Ga., at $46,127.

NASHVILLE, TENN.—The contract for a brick sewer in Market St. has been awarded to J. R. Randolph, at $3,933.

NEWPORT, KY.—The engineer has been directed to advertise for bids for constructing sewers in 17 streets. M. J. Costigan, Cy. Clk.

ATHENS, O.—Bids are asked until July 2, instead of July 18, as stated last week, for constructing a system. W. B. Golden, Village Clk.

BRIDGEPORT, O.—Bids are asked until July 12 for constructing about six miles of pipe sewers, as stated in our advertising columns. C. W. Howell, Cy. Clk.

CLEVELAND, O.—Plans have been prepared for constructing sewers in five streets.——The board of control has received the following bids for two sewers:

	Emmet St.	Cumberland St.
Campbell Bros	$869	$2,852
Helm & Lehman	960	3,364
H. L. Heilbron	976	.....
Kuentz Bros	976	3,518
F. W. Dennart	1,065	2,886
H. F. Leypoldt	1,077	3,766
F. Hlavin	1,154	2,694
Phillips & Bixel	1,299	.....
Ford P. Beers	1,132	3,631
William H. Patchett	1,246	4,736
McCracken & McDowell	1,208	2,683
Petry & Kuentz	1,178	4,072

CONNERSVILLE, IND.—J. M. Waldrik, Cy. Clk., writes us that surveys and plans have been prepared by John A. Cole, Chicago, and that bids will probably soon be asked for constructing a system. Bonds have not yet been sold.

MANSFIELD, O.—The council has passed a resolution to issue $40,000 of 6% bonds for sewage disposal works. F. M. Remy, Cy. Clk.

NEWARK, O.—Bids are asked until July 5 for constructing pipe sewers in North Third St. W. A. Irvine, Cy. Clk.——It is proposed to construct sewers in district No. 2.

BATTLE CREEK, MICH.—The council has voted to issue bonds for $10,000 for sewers.

DETROIT, MICH.—The board of public works has received the following bids for an outlet sewer through Owen Park: W. P. Langley, $42,234 (awarded contract); Langley & Jeynes, $42,267; Liphardt & Winterhalter, $44,243; John Wagner, $43,318.

CHICAGO, ILL.—The Moloney Sewerage Co. has been incorporated; capital stock, $5,000; incorporators, John B. Moloney, John Dooling and Maurice Flickles.——Bids are asked until July 5 for constructing sewers in 23 streets. H. J. Jones, Comr. Pub. Wks.

MADISON, WIS.—Plans have been prepared for constructing sewers in Park St. O. S. Norsman, Cy. Clk.

FARIBAULT, MINN.—Bids are asked until July 9 for constructing 6,980 ft. of 15 to 8-in. pipe sewers. Engr., C. F. Loweth, 94 E. Fourth St., St. Paul. B. B. Sheffield, Mayor.

INDEPENDENCE, MO.—The council is discussing the construction of a system.

DENVER, COLO.—The aldermen have proposed that the Delgany St. sewer extension be constructed in five or six sections, and that the work be done by contract.

SAN FRANCISCO, CAL.—The finance committee is expected to appropriate $18,000 for rebuilding the 6 × 6 ft. brick sewer in 14th St.

SALT LAKE CITY, UTAH.—The health commissioner has recommended that the government construct a sewer from Fort Douglas to this city, estimated to cost $30,000.

WINNIPEG, MAN.—It is proposed to construct a main sewer in Scott St. C. J. Brown, Cy. Clk.

VICTORIA, B. C.—Bids are asked until Aug. 1 for the purchase of $100,000 of 4½% sewer bonds. W. I. Dowler, Cy. Clk.

STREETS.

PROVIDENCE, R. I.—The council will soon be petitioned to have a road 2,100 ft. long constructed in Ward 4. The city engineer estimates the cost of three bridges that would be needed at $100,000.

BROOKLYN, N. Y.—The committee has recommended the paving and repaving of three streets, estimated to cost $21,200.——Bids are asked until July 6 for grading and paving two streets with cobblestones and two with Belgian blocks; and until July 10 for paving one street with cobblestones and one with Belgian blocks. A. T. White, Comr. Cy. Wks.

GLOVERSVILLE, N. Y.—The contract for paving several streets with brick has been awarded to William Ficklin & Son, Chicago, Ill. The bids are given under Contract Prices.

NEW YORK, N. Y.—Bids are asked by the commissioner of street improvements of the 23d and 24th Wards, 2622 Third Ave., until July 5 for grading and improving sidewalks in three streets and paving one street with trap blocks and one with granite blocks.——Bids are asked by the department of public works until July 10 for improving two streets.

POUGHKEEPSIE, N. Y.—Bids are asked until July 2 for paving Main St. with brick, as stated in our advertising columns. John J. Ruddy, Cy. Chamberlain.

SYRACUSE, N. Y.—The council has received the following bids for paving West Genesee St. with Trinidad Lake asphalt: Warren-Scharf Asphalt Paving Co., $69,120; Trinidad Asphalt Refining Co., $69,867; Syracuse Improvement Co., $68,433 (awarded contract). The following bids were received for paving another portion of the same street with brick: Buffalo Paving Co., $96,721; G. D. Grannis, $99,003; Homer & Co., $88,674 (awarded contract).

TROY, N. Y.—Bids are asked until July 6 for paving Division St. with brick. E. O. Ross, Secy. Contracting Bd.

JERSEY CITY, N. J.—Bids are asked until July 9 for 13,700 sq. yds. of macadam and 1,950 sq. yds. of stone paving. G. T. Bouton, Clk. Bd. St. Comrs.

PASSAIC, N. J.—The contract for macadamizing Pennington Ave. has been awarded to F. J. Marley, Little Falls, at about $10,000.

BRADFORD, PA.—The city engineer has been directed to make plans and estimates for paving Main St. with brick.

WASHINGTON, PA.—Bids are asked by the council of East Washington until July 2 for paving a portion of Wade St. with brick.

ERIE, PA.—The council has passed ordinances for paving three streets.

NEWCASTLE, PA.—The council has passed ordinances for paving North Mercer St. with asphalt blocks and South Mercer St. with brick.

WAYNESBORO, PA.—The citizens have voted to issue $15,000 in street improvement bonds.

WEST CHESTER, PA.—The citizens have voted to issue $30,000 of additional bonds for public improvements.

BALTIMORE, MD.—Bids are asked until July 5 for furnishing 280,000 Belgian blocks, 6,000 lin. ft. of 6-in. curbing and 13,000 lin. ft. of gutter stones. A. E. Smyrk, Cy. Comr.

CATLETTSBURG, KY.—It is reported that this place will issue $80,000 in bonds for paving.

ASHLAND, O.—Bids are asked until July 16 for the purchase of 6% street improvement bonds.——It is proposed to pave two streets with brick, estimated to cost $20,500. C. G. Ducomb, Cy. Clk.

CINCINNATI, O.—Bids are asked until July 21 for the purchase of $200,000 of 5% pavement bonds. D. W. Brown, Cy. Audr.——Bids are asked by the board of administration until July 21 for grading and paving Winslow Ave. with brick.

SANDUSKY, O.—The city engineer estimates the cost of paving Wayne St. with Trinidad asphalt at $47,374, and for paving another portion of the same street at $7,760.——The council has received bids for paving East Market St. with various kinds of brick and granite; the following being the bids received for Mack standard blocks:

McKean & Callan	$12,951
G. W. Doerzbach	14,057
V. W. Coons & Son	13,445
De Groodt & Son	14,202
Jacobs & Stewart	13,615
Boren & Conley	13,814
Damn & Boebel	15,022
C. B. Hall	13,296
Carl Schneider	11,820
Hartman & Richardson	11,885

MILAN, ILL.—It is reported that 20 blocks of sidewalks will soon be paved with brick.

PEORIA, ILL.—The council has received the following bids for paving Perry St. with asphalt: Fruin-Bambrick Construction Co., St. Louis, Mo., $62,789, and Warren-Scharf Asphalt Paving Co., $64,328.

RACINE, WIS.—The contract for paving Junction Ave. has been awarded to N. F. Reichert & Co., Racine, at $4,409.

DAVENPORT, IA.—The Des Moines Brick Co. is reported to have been awarded contracts for paving at about $22,000.

BOZEMAN, MONT.—The council has ordered that

16 blocks of Main St. be paved with telford macadam, at an estimated cost of $30,000

KANSAS CITY, MO.—It is reported that about 12 miles of streets paved with cedar blocks need repairing, and a city official has recommended that the work be done at once.

SEDALIA, MO.—Edward Hough, Cy. Clk., writes us that it is proposed to spend $17,000 for asphalt paving, and $7,200 for macadamizing streets.

ST. LOUIS, MO.—The lowest bids for six contracts for paving with asphalt were those of the Hill-O'Meara Asphalt Construction Co. (Bermudez asphalt), at $214,710; the Barber Asphalt Paving Co. bid $243,028.

DUBLIN, TEX.—The citizens have voted to issue $8,000 in bonds for public improvements.

CHATHAM, ONT.—The committee has recommended that bids be asked for the paving of Queen and Thames Sts. with brick upon 6-ins. of concrete, with cobblestone gutters and artificial stone sidewalks, at an estimated cost of about $24,000.

WINNIPEG, MAN.—The council has adopted ordinances for constructing 11,680 ft. of gravel road; 6,500 ft. of cedar block pavements, and 2,410 ft. of macadam. C. J. Brown, Cy. Clk.

ELECTRIC LIGHT AND POWER.

BANGOR, ME.—The erection of a new electric light plant is being discussed, according to reports.

BRANFORD, CONN.—It is reported that a company is being formed to put in an electric light plant.

BROOKLYN, N. Y.—The Municipal Electric Light Co. has petitioned the aldermen for a franchise to establish an electric plant to light seven wards.——It is stated that franchises will be granted to the State Electric Light & Power Co. and to the Kings County Electric Light Co.

KEARNEY, N. J.—Bids are asked until July 10 for 80 to 125 arc lights for five years. G. B. Reid, Township Clk.

SUMMIT, N. J.—G. V. Muchmore has submitted plans for a proposed electric light plant.

MILLERSVILLE, PA.—Bids are asked until July 16 for an electric light plant at the normal school. W. A. Drysdale, Consult. Engr., Hale Bldg., Philadelphia.

NORWOOD, PA.—Bids are asked until July 12 for furnishing 50 to 100 street lights for two years. G. C. Skelton, Secy.

JACKSONVILLE, FLA.—Plans have been submitted for an electric light plant, and an ordinance has been presented to the board of public works for authority to advertise for bids.

JACKSON, TENN.—Bids are asked for the material and erection of a steam and electric light plant of about 200-HP. capacity. Specifications, information, etc., can be obtained by addressing Patterson & Shipman, 1416 F St. N. W., Washington, D. C.

PADUCAH, KY.—Bids are asked by the committee until July 6 for an electric light plant.

NAPOLEON, O.—Bids are asked until July 24 for constructing an electric light plant, as stated in our advertising columns. Engr., J. B. Strawn, Salem. Josiah Koller, Secy. Bd.

MILWAUKEE, WIS.—The committee on electric lighting is investigating the advisability of municipal ownership of a plant.

OSAGE, IA.—The Osage Electric Light Co.'s plant was destroyed by fire on June 21; loss, $50,000.

SIOUX CITY, IA.—The contract with the Sioux City Electric Co. expires in August and the committee is investigating the putting in of a municipal plant, estimated to cost $75,000.

GRAND ISLAND, NEB.—The contract with the Electric Light & Fuel Co. expires July 1, and the new bids of the company have been rejected by the council. The city is now paying $16 per light per month for 25 lights.

CAPE GIRARDEAU, MO.—R. E. & T. W. Gannon, who have a franchise for water-works, have been awarded a contract for lighting the city with arc lights.

JOPLIN, MO.—The Southwestern Electric Light & Water Power Co. is reported as about to erect a large electric plant within the city limits. The present plant is at Grand Falls, four miles distant.

ANAHEIM, CAL.—The estimated cost of a proposed electric light plant is $5,000.

LOS ANGELES, CAL.—The council has been petitioned by Charles Walton for a franchise to put in an electric light plant.

OGDEN, UTAH.—Surveys are being made for the proposed plant of the Pioneer Electric Power Co.

NEW COMPANIES.—Rogers Park Lighting Co., Chicago, Ill.; $30,000; Henry Heistend, Geo. H. Stone, L. C. Kirkland.——Emmons Electric Co., Chicago, Ill.; $50,000; C. P. Emmons, F. J. Tank, James Perry.——Pine Grove & Tremont Electric Light, Heat & Power Co., Pine Grove, Pa.; $33,000; Treas., J. F. Wentz.——Coraopolis Electric Light Co., Coraopolis, Pa.; $5,000; Treas., H. W. Burns.——Carroll County Electric Light & Power Co., Westminster, Pa.; $5,000; Pres., Milton Shaeffer; Secy. and Treas., F. D. Miller; Gen. Man., A. L. Bosley.——Fredericktown Electric & Mfg. Co., Fredericktown, Mo.; $6,000; H. O. Thorst, W. R. Nifong, W. E. Bailey.——Clarksville Electric Light Co., Clarksville, Tenn.; E. B. Tyler, J. F. McDermott, H. C. Merritt, E. P. Ely, E. L. Lockert.——Infinity Mfg. Co., New York, N. Y.; $4,000; to manufacture electric dry batteries and other electric appliances; J. J. Soloman, D. B. Hart, J. L. Hart.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

STEAM ROAD ROLLER.—Cincinnati, O.—Bids are asked by the board of administration until July 5 for a 25,000-lb. steam road roller.

GAS PLANTS.—Martinsville, Ind.—The city has purchased a site for the erection of a plant for the manufacture of gas for fuel and lighting purposes.

DRAINAGE CANAL.—Chicago, Ill.—Bids are asked until Aug. 22 for excavating section 15 of the drainage canal, as stated in our advertising columns. Thos. F. Judge, Clk.

STEAM BOILER.—Baltimore, Md.—Bids are asked until July 2 for a steam boiler similar to the one now in use at the Light St. drawbridge. Apply to John C. Burnup, Engr.

FIRE ENGINE AND WATER TOWER.—St. Joseph, Mo.—The aldermen have appropriated $8,600 for a steam fire engine and a water tower, for which the city comptroller will probably soon receive bids.

JAIL.—Des Moines, Ia.—Bids are asked until July 7 for furnishing and setting complete a jail or set of eight cages or cells for a room 33 x 27 ft. and 9½ ft. high. Ed. Wright and John Sherman, Bd. Pub. Wks.

POWER HOUSE AND OFFICE BUILDING.—Detroit, Mich.—Bids are asked until July 28 for a power house and office building for the 800-ft. lock, St. Marys Falls Canal, as stated in our advertising columns. Col. O. M. Poe, U. S. Engr.

STEAM HEATING, ETC.—Chicago, Ill.—The board of education will receive bids until July 2 for masonry work, steam heating, mechanical ventilation, furnaces, plumbing, etc., in connection with eight school houses. Ch. Engr., T. J. Waters, 1112 Schiller Bldg.

FLOOR ARCHES, ETC.—Washington, D. C.—Bids are asked until July 19 for the brick and terra cotta floor and ceiling arches, etc., for the U. S. building at Worcester, Mass., as stated in our advertising columns. Jeremiah O'Rourke, Supervising Arch. Treasury Dept.

DISINFECTING PLANT.—Brooklyn, N. Y.—The contract for the erection of a disinfecting plant for the Kingston Ave. hospital has been awarded to John D. Anderson's Sons, Brooklyn, at $17,223. Wm. S. Johnson, Sanitary Engr., writes us that the disinfector will be of the Blake & Williams pattern.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
June 29.	Street improvement bonds,	Norwood, O.	June 7
June 29.	Sewers,	Kansas City, Mo.	June 21
June 29.	Sewers,	Louisville, Ky.	June 21
June 29.	Paving sidewalks,	Louisville, Ky.	June 21
June 29.	Pipe, reservoir, etc.,	Toronto, Ont.	June 21
June 29.	Boilers,	Troy, N. Y.	June 28
June 30.	Bridge,	Marion, Ind.	June 7
June 30.	Ditch,	Washington, Ind.	June 7
June 30.	Highways,	Cincinnati, O.	June 14
June 30.	Bonds,	Faribault, Minn.	June 14
June 30.	Railway excavation,	Evansville, Ind.	June 21
	Advertised, Eng. News, May 24 to June 14.		
June 30.	Lining tunnel,	Evansville, Ind.	June 21
	Advertised, Eng. News, May 24 to June 14.		
June 30.	Brush, etc.,	Memphis, Tenn.	June 21
	Advertised, Eng. News, June 21, 28.		
June 30.	Sewers,	Massillon, O.	June 21
June 30.	Sewers,	Sandusky, O.	June 21
June 30.	Pipe sewers,	Bloomfield, N. J.	June 28
July 1.	Sewer bonds,	Wallace, Idaho	May 31
July 1.	Water-works,	Lancaster, N. Y.	June 7
	Advertised, Eng. News, June 7 and 14.		
July 1.	Bridge,	Warren, O.	June 14
	Advertised Eng. News, June 14 and 21.		
July 1.	Sewer bonds ($50,000),	Stamford, Conn.	June 21
July 1.	Bridge,	Murphy, N. S.	June 21
July 2.	Water-w'ks system,	Centreville, S. Dak.	May 31
July 2.	Paving,	Dayton, O.	June 7
July 2.	Bridge,	Hastings, Minn.	June 7
	Advertised, Eng. News, June 7.		
July 2.	Bridge,	Tower City, Pa.	June 14
July 2.	Water bonds,	Ipswich, Mass.	June 21
July 2.	Sewers,	Athens, O.	June 21
July 2.	Water bonds,	Bellevue, O.	June 21
July 2.	Paving (67,180 sq. yds.),	Dayton, O.	June 21
July 2.	Sewer & St. imp'v't bonds,	Allegheny, Pa.	June 21
July 2.	Sewers,	Bath-on-Hudson, N. Y.	June 28
July 2.	Brick paving,	Poughkeepsie, N. Y.	June 28
	Advertised, Eng. News, June 28.		
July 2.	Pipe sewers (4,912 ft.),	Bradford, Pa.	June 28
July 2.	Sewers,	Greensburg, Pa.	June 28
July 2.	Brick paving,	Washington, Pa.	June 28
July 2.	Sewers,	Athens, O.	June 28
July 2.	Bridges,	Albion, Mich.	June 28
	Advertised, Eng. News, June 28.		
July 2.	Steam heating, etc.,	Chicago, Ill.	June 28
July 2.	Steam boiler,	Baltimore, Md.	June 28
July 3.	Pipe,	Victoria, B. C.	May 24
July 3.	Metal work at Key West,	Fla.	June 7
	Advertised, Eng. News, June 7 to 28.		
July 3.	Electric lighting,	Hopkinsville, Ky.	June 7
July 3.	Sewer bonds,	Hamilton, O.	June 7
July 3.	Heat'g, vent'g apparatus,	Lowell, Mass.	June 14
	Advertised, Eng. News, June 14 and 21.		
July 3.	Paving,	Dunkirk, N. Y.	June 14
	Advertised, Eng. News, June 14 and 21.		
July 3.	Paving,	York, Pa.	June 14
	Advertised, Eng. News, June 14 to 28.		
July 3.	Sewers,	Hamilton, O.	June 14
July 3.	Brick paving,	Lima, O.	June 14
July 3.	Bridge,	Jersey Shore, Pa.	June 21
July 3.	Irrigation bonds,	Linda Vista, Cal.	June 28
July 3.	Well,	Ashland, Wis.	June 28
July 5.	Water-works system,	Waukegan, Ill.	June 21
	Advertised, Eng News, June 21, 28.		
July 5.	Water-works and bonds,	Wilber, Neb.	June 14
July 5.	Paving,	New York, N. Y.	June 28
July 5.	Belgian blocks, etc.,	Baltimore, Md.	June 28
July 5.	Steam road roller,	Cincinnati, O.	June 28
July 5.	Pipe sewers,	Newark, O.	June 28
July 5.	Sewers (23 streets),	Chicago, Ill.	June 28
July 6.	Water-works,	Jefferson, Ia.	June 14
	Advertised, Eng. News, June 14 to 28.		
July 6.	Heat'g, vent'g apparatus,	Ft. Dodge, Ia.	June 14
	Advertised, Eng. News, June 14 and 21.		
July 6.	Heat'g, vent'g apparatus,	Houlton, Me.	June 21
	Advertised, Eng. News, June 21, 28.		
July 6.	Sewers (13,067 ft.),	Wooster, O.	June 21
July 6.	Paving,	Wooster, O.	June 21
July 6.	Bridge,	Red Wing, Minn.	June 21
	Advertised, Eng. News, June 21, 28.		
July 6.	Water-works,	Earlville, N. Y.	June 21
July 6.	Brick paving,	Troy, N. Y.	June 28
July 6.	Brick sewers,	Williamsport, Pa.	June 28
	Advertised, Eng. News, June 28.		
July 6.	Paving,	Brooklyn, N. Y.	June 28
July 7.	Water-works,	St. Bernard, O.	June 7
	Advertised, Eng. News, June 7 to 21.		
July 7.	Electric light plant,	St. Bernard, O.	June 7
	Advertised, Eng. News, June 7 to 21.		
July 7.	Street improvements,	Mansfield, O.	June 14
July 7.	Jail,	Des Moines, Ia.	June 28
July 7.	Water-works system,	Glasgow, Mo.	June 28
July 9.	Bridge,	Dallas, Tex.	June 7
July 9.	Plans for city hall,	Peoria, Ill.	June 14
July 9.	Electric w'ring,	Dallas, Tex.	June 14
July 9.	Paving,	Meriden, Conn.	June 21
	Advertised, Eng. News, June 21.		
July 9.	Light fixtures,	Washington, D. C.	June 21
July 9.	Pipe, etc.,	Downer's Grove, Ill.	June 21
	Advertised, Eng. News, June 21 to July 5.		
July 9.	Water-works system,	Bellevue, Ia.	June 21
	Advertised, Eng. News, June 21.		
July 9.	Fire engines,	Houston, Tex.	June 21
July 9.	Paving,	Jersey City, N. J.	June 28
July 9.	Pipe sew'rs (6,980 ft.),	Faribault, Minn.	June 28
July 10.	Bridge,	Cathlamet, Wash.	May 31
July 10.	Masonry arch work	New York, N. Y.	June 14
July 10.	Macadam,	Elizabeth, N. J.	June 21
July 10.	Pipe sewers,	Buffalo, N. Y.	June 28
July 10.	Electric lighting,	Kearney, N. J.	June 28
July 10.	Water-tower,	Toledo, O.	June 28
July 10.	Paving,	Brooklyn, N. Y.	June 28
July 10.	Street improvements,	New York, N. Y.	June 28
July 11.	Bonds ($3,000,000),	Chicago, Ill.	June 21
July 12.	Bridge subst'r & appr'chs,	Cleveland, O.	June 21
July 12.	Water-works system,	Edwards, N. Y.	June 28
July 12.	Sewers (6 miles),	Bridgeport, O.	June 28
	Advertised, Eng. News, June 28 and July 5.		
July 12.	Pipe, stand-pipe, etc.,	Kirkwood, Ill.	June 28
	Advertised, Eng. News, June 28.		
July 12.	Bridge superstructure,	Winnipeg, Man.	June 28
July 12.	Pipe sewers,	Buffalo, N. Y.	June 28
July 14.	Paving,	Akron, O.	June 21
July 14.	Street improvements,	Avondale, O.	June 21
July 14.	Stand-pipe,	Zanesville, O.	June 21
July 14.	Water-wks syst'm,	Northumberland, Pa.	June 28
	Advertised, Eng. News, June 28.		
July 16.	Paving (50,435 sq. yds.),	Dayton, O.	June 21
July 16.	Electric light plant,	Millersville, Pa.	June 28
July 16.	Water-works system,	Grafton, W. Va.	June 28
	Advertised, Eng. News, June 28 to July 12.		
July 16.	Street improvement bonds,	Ashland, O.	June 28
July 17.	Stone work,	Newport, R. I.	June 7
	Advertised, Eng. News, June 7 to 28.		
July 17.	Street improvements,	Bucyrus, O.	June 21
July 17.	Water-wks. franchise,	Kaukauna, Wis.	June 28
	Advertised, Eng. News, June 28 to July 12.		
July 18.	Sewers (17,070 ft.),	Dayton, O.	June 21
July 18.	Paving,	Cleveland, O.	June 21
July 19.	Floor arches, etc.,	Worcester, Mass.	June 28
	Advertised, Eng. News, June 28 and July 5.		
July 21.	Paving bonds ($200,000),	Cincinnati, O.	June 28
July 21.	Brick paving,	Cincinnati, O.	June 28
July 24.	Water-works,	Napoleon, O.	June 28
	Advertised, Eng. News, June 28 and July 5.		
July 24.	Electric light plant,	Napoleon, O.	June 28
	Advertised, Eng. News, June 28 and July 5.		
July 28.	Power-house and bldg.,	Detroit, Mich.	June 28
	Advertised, Eng. News, June 28 to July 12.		
July 31.	Bridge,	New Westminster, B. C.	June 21
Aug. 1.	Sewer bonds ($100,000),	Victoria, B. C.	June 28
Aug. 6.	Electric lighting,	Rome, N. Y.	June 14
Aug. 22.	Drainage canal,	Chicago, Ill.	June 28
	Advertised, Eng. News, June 28 to Aug. 14.		
Sept. 1.	Electric lighting,	Portland, Ore.	June 21
No date.	Stairway, etc.,	Canton, O.	June 21
	Advertised, Eng. News, June 21, 28.		
"	" Water-works system,	Dansville, N. Y.	June 28
"	" Sewers,	Chester, Pa.	June 28
"	" Electric plant,	Jackson, Tenn.	June 28
"	" Wooden bridge,	Marietta, Ind. T.	June 28
"	" Artesian well,	Oak Cliff, Tex.	June 28

CONTRACT PRICES.

PIPE.—Rochester, N. Y.—E. Kulchling, Ch. Engr., writes us that the following bids were received June 15 for 5,952 net tons of cast iron pipe and special castings; Howard-Harrison Iron Co., Bessemer, Ala., 2,840 tons 36-in. medium, at $18; 50 tons specials, at $50; total, $53,870 (awarded contract); Radford Pipe & Foundry Co., Radford, Va., 816 tons, 30 to 6-in., at $18.30; 25½ tons of specials, at $45; total, $16,080 (awarded contract); Camden Iron Wks., Camden, N. J., 1,810 tons 36-in., heavy and medium, $19.35; total, $35,024; Reading Foundry Co., Reading, Pa., 1,000 tons 36-in. and 644 tons 30-in. medium, at $19.60; 36 and 30-in. specials, at $50 (plain hub specials, $45), and 20 to 6-in. at $42; total, $37,829; McNeal Pipe & Foundry Co., Burlington, N. J., 2,172 tons 36 to 6-in., at $20.25; 48½ tons specials, at $47 (flanged specials, $70); total, $46,263. No bid was received for 1,792 tons of 36-in. light weight pipe.

WATER-WORKS SUPPLIES.—Sandusky, O.—Contracts have been awarded as follows, according to local papers: 40,600 ft. of 12 to 4-in. cast iron pipe, Lake Shore Foundry, Cleveland, at $16.30 per ton; 50 6-in. and 25 8-in. valves, Eddy Valve Co., Waterford, N. Y., at $11 and $16 each, respectively. The bids for 65 fire hydrants were rejected.

Nashville, Tenn.—The following contracts have been awarded for water-works supplies: 550 pieces of 8 and 6-in. pipe, Dennis Long & Co., Louisville, Ky., at $16.74 per ton; special castings, S. E. Jones' Sons, Nashville, at 2 cts. per lb.; 3 tons of pig lead, National Lead Co., Louisville, Ky., at $3.27 per 100 lbs.; 15 fire hydrants, Michigan Brass & Iron Wks., Detroit, at $19.68 each.

GRADING.—Racine, Wis.—Williams & Jones, Racine, have been awarded contracts for grading two streets, at 11¾ and 12¾ cts. per cu. yd.

DREDGING.—Racine, Wis.—A contract for dredging Root River has been awarded by the board of public works to S. O. Dixon, Racine, at 19¾ cts. per cu. yd.

DREDGING AND FILLING.—Boston, Mass.—Frank W. Hodgdon, Engr. Harbor Comrs., writes us that the bids for dredging in Boston Harbor and filling 127,000 cu. yds. in South Boston flats were as follows: Boynton Bros., 65 cts. per cu. yd.; New England Dredging Co., 46 cts.; Bay State Dredging Co., 55 cts. The bids are considered rather high and are still under consideration.

ELECTRIC LIGHTING.—Williamsport, Pa.—The council has passed an ordinance contracting with the Beacon Electric Co. for 175 arc lights for five years, at $80 per light per year, the company to use the round carbon and the direct current. All 2,000-c. p. arc lights are to have an electrical efficiency of at least 450 watts. The company is to erect a suitable electric light plant at its own expense. It can use water power if it desires, but must equip its plant with steam power to enable it to furnish light in times of low or high water.

POWER HOUSE FOUNDATION.—Austin, Tex.—The contract for constructing the power house foundation has been awarded to Brown & Dabney, Dallas, at $18,205, the prices being as follows: Pumping, etc., $2,500; rock excavation, above zero, $1.60 per cu. yd.; below zero, $2.50; concrete, $7; stone masonry, $5.50. The other bids were: M. P. Kelley, $24,070; M. Sullivan, $18,345; H. L. Breneman, $22,652; Beiges & Waterson, $22,867; Wm. Walsh & Co., $21,955.

ASPHALT AND BRICK PAVING.—Montgomery, Ala.—The lowest bid for paving Dexter St. with brick was that of the Brick & Tile Co., at $1.78 per sq. yd. The Warren-Scharf Asphalt Paving Co. bid $2.46 for asphalt.

RAILWAY TRACK SCALE.—Cleveland, O.—The following bids were received by J. H. Farley, Dir. Pub. Wks., on June 13, for furnishing a standard gage railway track scale of 60 tons capacity; platform 36 ft. long:

	Buffalo Scale Co.	Howe Scale Co.	Standard Scale & S'ply Co.
For a foundation complete:			
Brick with concrete bottom	$245	$200	$575
" without " "	215	185	500
Stone with concrete bottom	255	200	575
" without " "	225	185	500
For track scale	430	495	360

SEWER MATERIALS.—Brunswick, Me.—The following bids were received last month for sewer materials: Pipe—Waldo Bros., earthern pipe, 75% off list price, no breakage allowed, or 65% f. o. b. Brunswick; D. W. Lewis, 76½% less freight; Portland Stoneware Co., 70½% for standard, 62% for extra mouth, 45% for 18-in. double strength. Brick—Granite State Brick Co., Boston, $9.30; E. S. Hackee & Sons, Brunswick, $7. Cement—Hoffman and Newark Rosendale brands, $1.25 per bbl. f. o. b. cars, or $1.35 on line of work; Booth's Portland, $2.58 or $2.68. Manhole castings per set:

Bath Iron Wks., Bath, Me.	$8.95
Concord Foundry Co., Concord, N. H.	6.23
P. C. Holmes Co., Gardiner, Me.	14.50
Builders' Iron Foundry Co., Providence, R. I.	10.20
Waltham Foundry Co., Waltham, Mass.	8.25
Le Baron Foundry Co., Middleboro, Mass.	5.83
Pratt & Cady Co., Hartford, Conn.	6.50
Lewiston Machine Co., Lewiston, Me.	9.88
Noble Stone Co., Lynn, Mass.	6.31
Osgood & Hart, Charlestown, Mass.	6.40
Daniel Kelly & Son, Portland, Me.	7.35

SEWERS.—Milwaukee, Wis.—The contract for section 2 of the 30th St. tunnel sewer has been awarded to John J. Crilley, at $19.70 per lin ft. This section is 10 ft. in diameter and 1,676 ft. in length. The bids received for section 1 of this work were published in our issue of Nov. 30, 1893.

Brooklyn, N. Y.—Bids were opened June 22 for constructing section 1 of the Greene Ave. relief sewer extension and the contract will probably be awarded to the lowest bidder about July 2, all bids received by the city being required to be advertised six days previous to the awarding of a contract. The work will be in open trench; average cut about 36 ft. The bids were as follows:

Bids Received for Section 1, Greene Ave. Relief Sewer Extension, Brooklyn, N. Y.

Quantities.	Geo. S. Good, LockHaven, Pa.	Jas. F. Gillen, 289 Clifton Pl., Brooklyn.	Charles Hart, 831 Third St., Brooklyn.	Robt. Furey, 10 Eighth Ave., Brooklyn.	Thos. Stratford, 134 Berkley Pl., Brooklyn.	Cranford & Co., 16 Court St., Brooklyn.	John McNamee, 16 Court St., Brooklyn.	D. J. Creem, 746 Jefferson Ave., Brooklyn.	Jas. J. Moran, 5 Court Square, Brooklyn.
120-in. b'k, 3,335 ft., per lin. ft.	$42.00	$26.60	$36.90	$30.96	$35.20	$30.75	$34.00	$27.00	$23.60
60-in. " 4,600 " " " "	11.10	8.50	10.50	9.10	8.20	8.25	8.00	7.00	6.60
48-in. " 930 " " " "	10.70	5.00	7.15	6.60	7.80	6.40	7.00	5.00	4.50
42-in. " 2,320 " " " "	7.50	5.00	5.88	4.59	5.20	4.50	4.50	4.00	4.00
36-in. " 3,440 " " " "	7.65	4.00	5.46	5.30	4.20	5.21	5.25	3.50	3.75
24-in. pipe, 1,000 ft., per lin. ft.	2.40	2.00	4.00	2.50	1.60	2.50	2.40	1.79	2.40
18-in. " 100 " " " "	1.20	1.50	3.00	2.31	1.20	2.25	1.70	0.95	1.80
15-in. " 160 " " " "	1.00	1.25	2.75	2.17	1.15	2.15	1.40	0.85	1.50
12-in. " 6,350 " " " "	1.00	0.85	1.10	1.62	0.80	1.50	1.00	0.75	0.93
Manholes, complete, 150, each	43.00	27.00	32.00	36.00	32.00	36.00	36.00	29.00	35.00
Street basins, " 40, "	90.00	100.00	110.00	100.00	90.00	100.00	115.00	93.00	115.00
Greene Ave. manholes, 4, each	90.00	100.00	300.00	103.00	200.00	100.00	175.00	75.00	110.00
Planking, 1,000 M. ft., per M. ft.	32.00	16.00	20.00	31.00	19.50	23.00	20.00	14.00	16.00
12-in. drain tile, 3,335 ft., pr lin. ft.	0.45	0.10	0.50	0.40	0.25	0.50	0.40	0.10	0.32
Total amount	$297,738	$190,352	$254,227	$235,642	$225,396	$221,877	$226,378	$177,702	$169,513

ASPHALT PAVING.—Denver, Colo.—The total bids for paving East Larimer St. with asphalt were as follows: 1, Blake Asphalt Co., Denver (California asphalt), $119,965; 2, F. O. Blake, said to represent Chicago parties (California asphalt), $91,680; 3, Western Bermudez Asphalt Co., Detroit, Mich. (Bermudez asphalt), $115,648; 4, Colorado Paving Co. (Trinidad Lake asphalt), $117,425. The prices were as follows:

	1.	2.	3.	4.
Paving, per sq. yd.	$3.02	$2.41	$2.90	$3.04
6 × 15-in. sandstone curb, per ft.	1.17	.75	1.10	1.02
6 × 18-in. " " " "	1.30	.82	1.15	1.14
6 × 20-in. " " " "	1.41	.87	1.25	1.25
4-in. sub-curb " "	.97	.70	.80	.81
6-in. vitrified drain " "	.70	.60	1.00	.60
10-in. " " " "	.83	.65	.90	.70
12-in. " " " "	.91	.85	1.00	.85
Receiving basins,	each. 79.00	60.00	75.70	75.70
Manholes,	" 45.00	35.00	55.00	35.00
Inverted siphon wells,	" 35.00	10.00	30.00	25.00
Cast iron siphon well tops,	" 6.00	5.00	6.00	9.00
" " ext. rings for tops,	" 15.00	2.90	6.00	4.00

CRUSHED STONE AND CEDAR BLOCKS.—Milwaukee, Wis.—A contract for $500 worth of crushed stone in Ward 4, has been awarded to P. J. Shea, at $1.11½ per cu. yd., and a contract for 500 sq. yds. of 6-in. cedar paving blocks to the Enterprise Block & Lumber Co., at 39 cts. per sq. yd.

GRANITE BLOCK PAVING.—Philadelphia, Pa.—Contracts for paving with granite blocks have been awarded as follows: Jas. A. Mundy & Bro., at $3.39 per sq. yd.; Michael O'Rourke, at $3.30 to $3.80; Thomas Cunningham, at $3.37 to $3.49; Mack Paving Co., at $3.45 to $3.65; T. P. Smart & Co., $3.30; O. McKenna, at $3.25 to $3.30.

CEDAR BLOCK PAVING.—Milwaukee, Wis.—A contract for 11,592 sq. yds. of paving with cedar blocks has been awarded to Wm. Forrestall at $1.12 per sq. yd.; stone curbing, 51 cts. per lin. ft.

Detroit, Mich.—There were 41 bids received for paving Langley Ave. with cedar blocks, the lowest being J. Conn, at $6,353, and H. A. Brossard, at $6,360. The lowest bid was $1.12 per sq. yd. for the paving alone and $1.48 for the work complete.

Freeport, Ill.—A contract for paving with cedar blocks has been awarded to Thatcher & Burke, at $24,751, the bids being as follows:

	Curb.	Paving.
J. B. Scott & Co., Chicago	$.45	$1.02
Rockford Construction Co., Rockford	.47	1.33
C. & T. Iglehart, Morgan Park	.46½	1.09
R. F. Conway, Chicago	.42	1.22
Minnehaha Granite Co., Chicago	.54½	1.12
Thatcher & Burke, Chicago	.42	.92⅞
Kennedy & McCann, Dubuque, Ia.	.43	.98
Mall & Doan, Aurora, Ill.	.45	1.24
Nagle, Holcomb & Co., Chicago	.45	1.04

BRICK PAVING.—Aurora, Ill.—J. M. Kennedy, Cy. Clk., writes us that the city is now doing the grading for 21,765 sq. yds. of brick paving, estimated to cost $37,109, the contract for which has been awarded to the T. B. Townsend Brick & Contracting Co., Zanesville, O., at $1.20 per sq. yd. This contract was awarded to the Rockford Construction Co., at $1.25, but the new council reawarded the work.

Altoona, Pa.—The "Tribune" states that the contract for paving Ninth St. has been awarded to Erdman Bros., Homestead, at $1.85 per sq. yd. for repressed brick, or $1.70 for stamped brick; curbing, 55 cts. per lin. ft.; resetting old curb, 7 cts.

Philipsburg, Pa.—A contract for paving 7,500 sq. yds. with vitrified brick, upon concrete, is reported to have been awarded to a Pittsburg firm, at $1.68 per sq. yd.; excavation, 24 cts, per cu. yd.; resetting curb, 8 cts. per lin. ft.

Detroit, Mich.—Liphardt & Winterhalter were the lowest bidders for paving Virginia Ave., at $1.96 per sq. yd., for Hallwood brick upon concrete; total, $5,962.

Gloversville, N. Y.—The contract for 16,200 sq. yds. of paving, recently noted, has been awarded to Ficklin & Co., Chicago, at $1.71 per sq. yd., for the Canton shale brick, with a 10-year guarantee. Bids were received for different varieties of brick, the range of the prices being about as follows, the first column including a 10-year guarantee, and the second column being without any guarantee:

Bidder.	Paving.		Ex. concrete per cu. yd.	Setting curb, per ft.
Seymour & Banker, Gl'v'ville.	$2.24¼	$2.24¼	....	....
" " " "	2.31½	2.21½	$5.20	$.28
Orr Bros., Alleghany, Pa.	2.07	2.07	....	....
" " " "	2.25	2.25	2.90	.24
J. H. Cavanaugh, Troy	2.30	2.30	3.30	.20
" " "	2.45	2.45	....	....
Wm. Ficklin & Co., Chicago	1.71	1.65	3.50	.06
*Barber Asphalt Co., N. Y.	2.50¼	....	5.00	.25
Park Pav'g Co., Roch'ster, Pa.	2.27	2.19	4.00	.20
" " " "	2.37	2.30	....	....
Pidgeon & Co., Albany	3.00	2.75	3.00	.26
Homer & Co., Olean	2.77	2.27	2.75	.30
S. C. Ferguson, Gloversville	....	2.09½	5.00	.35
Campbell & Wood, Ithaca	2.68	3.22	5.44	.21½
J. H. Drake, Syracuse	2.30	2.20	4.20	.35
" " "	3.10	3.00	....	....
C. A. & J. Smith, Glov'rsville	1.99	1.94	2.40	.17
" " "	2.33	2.28	....	....
Patrick McKenna, Troy	2.59	2.54	4.00	.30
" " "	2.48	2.37	2.85	....
" " "	2.80	2.70	3.00	....

* For asphalt paving.

Galesburg, Ill.—The following bids were received for paving the sides of the city reservoir with brick laid upon the 2 × 8-in. edge: Chas. Hawkins and Frank Johnson, 76 cts. per sq. yd.; Jas. O'Connor, 50 to 70 cts.; O. C. Lamphear, 70 cts.; G. L. Arnold, 75 cts.; N. P. Gann Construction Co., 60 cts.; J. B. Auley, 54 to 57 cts.

Urbana, Ill.—C. B. Holmes, Cy. Clk., writes us that the contract for paving Main, White and Elm streets has been awarded to Stipes & Loindley, Urbana, at $1.44 per sq. yd. for paving with two courses of extra hard burned paving brick upon 4 ins. of sand and gravel, and 9 cts. per lin. ft. for 2 × 12-in. oak plank curbing bolted to 4 × 6-in. posts placed 30 ins. in the ground, contractor to excavate to establish grade, etc.

Bids Received for Brick Paving at Peoria, Ill.

Bidder.	Excavation per cu. yd. 1.	2.	Res't'g curb per lin. ft. 1.	2.	Paving per sq. yd. 1.	2.	Total. 1.	2.
V. Jobst, 517 N. Adams St., Peoria	$0.25	$0.20	$0.06	$0.06	$1.50	$1.50	$27,764	$30,390
Cosgrain & McDonald, Chicago	.30	.25	.06	.05	1.51	1.49½	28,224	30,513
Robt. Clark, Peoria	.35	.20	.05	.05	1.47	1.47	27,749	29,721
J. S. Allen, Peoria	..	.25	..	.05	...	1.67	.....	33,842
Rockford Construction Co., Rockford	.30	.20	.05	.05	1.48	1.45	27,634	29,340
Henry Besler, Cedar Rapids, Ia.	.35	.25	.06	.06	1.39	1.39	26,440	28,615

Des Moines, Ia.—The contract for paving Terrace Way with brick has been awarded to the Des Moines Brick Mfg. Co., at $1.70 per sq. yd.

Ithaca, N. Y.—H. A. St. John, Supt., writes us that the contract for 7,000 sq. yds. of brick pavement, recently noted, has been awarded to Campbell & Wood, Ithaca, at $1.69 per sq. yd. for one course of brick upon 6 ins. of concrete; excavation, 32 cts. per cu yd.; 20-in. Medina curb, 52 cts. per lin. ft. Driscoll Bros. bid $2.09 for the paving; Sawders & Houston, Pittsburg, Pa., $1.92; Costello & Nagle, Elmira, $1.89 to $2.07.

Hornellsville, N. Y.—F. W. Dalrymple, Engr., writes us that the contract for the proposed brick paving has been awarded to W. E. Warren, Niagara Falls, at $1.63 per sq. yd. for one course of brick upon 6 ins. of concrete; excavation, 27 cts. per cu. yd.; 5 × 12-in. curb on 6 ins. concrete, with concrete backing, 39 cts. per ft.; drain tile, 5 cts. per ft.; total, $33,317. The other bids were as follows, in the above order:

A. D. Osborne, Binghamton	$1.84	$.28	$.45	$.10
Beckridge & Fay, Buffalo	1.69	.45	.30	.03
Homer & Co., Olean	1.66	.30	.50	.04
McNaughton & Dutro, Buffalo	1.64	.25	.60	.10
Fahy & Kelley, Hornellsville	1.86	.30	.49	.12

Peoria, Ill.—Jacob A. Harman, Cy. Engr., writes us that the following bids were received June 15 for paving two streets with one course of small brick upon 6 ins. concrete, (1) being the bid for Main St., where the excavation is of macadam roadway, and (2) for North Adams St., where the excavation is of old cedar block pavement; both contracts awarded to Henry Besler:

DREDGING.—New York, N. Y.—The department of docks has awarded the contract for dredging in the North River, recently noted, to the Atlantic Dredging Co., at 18¾ cts. per cu. yd.

INDUSTRIAL NOTES.

THE PENINSULAR ARTESIAN WELL CO., of Jacksonville, Fla., is arranging to put down wells and construct irrigating plants.

THE FORT WAYNE ELECTRIC CO., of Fort Wayne, Ind., will erect new buildings for the manufacture of electric street-car appliances on a large scale.

THE WARREN-SCHARF ASPHALT PAVING CO., of New York, has established an asphalt mixing plant at Charleston, N. C., where it has a large contract.

HERMAN PFISTER, manufacturer of engineers' instruments at Cincinnati, O., has removed his place of business from 195 West Fifth St. to more commodious quarters at 176-180 Plum St.

THE DOMINION BRIDGE CO., of Montreal, has the contract for 25 spans of iron bridge work on the Louisburg Railway for the Dominion Coal Co.; also for an iron span at Grand River, Richmond county, and one at Stony Brook, Inverness county.

THE LEWIS VALVE GEAR CO., of St. Louis, Mo., has received orders from the Chicago, Milwaukee & St. Paul, the Chicago & Northwestern and the Illinois Central railways for the equipment of some engines on these lines.

THE DETROIT FOUNDRY EQUIPMENT CO. has changed its name to Whiting Foundry Equipment Co. They have removed their main office to 225 Dearborn St., Chicago, and have occupied their new works at Harvey, Ill. Correspondence should be addressed to the Chicago office.

FRASER & CHALMERS, Chicago, have established a new branch office at 527 17th St., Denver, Colo., with Mr. H. R. Ayres in charge. They extend an invitation to visitors to Denver to make this office their headquarters, where facilities will be provided for carrying on correspondence, reference to periodical files, etc.

THE PENNSYLVANIA STEEL CO., of Steelton, Pa., is to be reorganized, as well as the Maryland Steel Co., which is owned in the same interests. The settlement with the creditors will embrace a payment of 40% in cash and 60% in consolidated bonds upon the plant at Steelton, Pa., the plant at Sparrows Point, Md., valuable ore mines in Cuba, and other property. These bonds will be secured to the amount of $7,000,000.

THE RADFORD PIPE & FOUNDRY CO., of Radford, Va., has decided upon a scheme of improvements, the object being a very considerable addition to the working capacity of the plant. The principal improvements in contemplation consist of an additional pit; considerable increase in the equipment of present pits; a new cupola of largest capacity (96-in. shell); additions to boiler capacity and to the track system within the works; an overhead traveling crane in the special foundry; a large steam crane for hoisting pig iron to the cupola platforms; additional coal and coke trestles etc. The company reports that it has pushed its plant to its fullest capacity since February, on orders from the East, and is compelled to refuse desirable business for lack of larger capacity. Contracts have already been let for part of the improvements. It is estimated that, when completed, they will very nearly double the daily output of pipe and special castings.

NEW COMPANIES.—Murphy Power Co., Chicago; capital stock, $3,000; Frank A. Murphy, Chas F. Allyn.——Western Electric Co., Chicago; $3,500,000.——Electric Boiler Co., Rochester, N. Y.; $50,000.——Kings, Queens & Suffolk Co., Brooklyn, N. Y.; $10,600,000; Wm. L. Wood, Fred. W. Dunton, Jamaica, N. Y.——Williams Palace Car Co., St. Joseph, Mo.; $3,000,000.——Union Malleable Iron Co., Moline, Ill.; $125,000; Chas. H. Deere, John W. Good, S. H. Volle.——Goliad Water Power Co., Goliad, Tex.; $30,000; Geo. W. Simmons, F. R. Starr, Jr., C. H. Baker.——Railway Specialty Co., Chicago; $200,000; C. S. Burton, E. T. Wray.

Sanitary District of Chicago.

TO CONTRACTORS.

Sealed proposals addressed to the Board of Trustees of the Sanitary District of Chicago, and indorsed "Proposal for Excavating a Portion of the Main Drainage Channel," will be received by the Clerk of the said Sanitary District at Room H, Rialto Building, Chicago, Ill., until 12 m. (standard time) of Wednesday, the 22d day of August, 1894, and will be publicly opened by the said Board of Trustees at the regular meeting held that day, or at a special meeting called for that purpose.

The work for which the said tenders are invited is the excavation of that portion of the main drainage channel for the said Sanitary District, known as contract section fifteen (15), extending from station 1,480 to station 1,520, and consists in all of about 639,000 cubic yards of rock, of about 35,300 cubic yards of earth, and the building of 40,000 cubic yards of retaining walls.

Each proposal to be accompanied by a certified check or cash to the amount of $5 000.

All certified checks to be drawn on some responsible bank doing business in the City of Chicago, and be made payable to the order of the Clerk of the Sanitary District of Chicago. Said amount of $5,000 to accompany each bid will be held by the Sanitary District until all of said proposals have been canvassed and contracts awarded and signed, the return of said check or cash to the bidder to whom said work shall have been awarded being conditioned upon his appearing within ten days after notice of such award being given, with bondsmen, and executing a contract with the Sanitary District for said work so awarded, and giving a bond satisfactory to the Board of Trustees for the fulfillment of the same in the amount of $100,000.

All proposals must be made upon the blank forms furnished by the Sanitary District, and must give the price for each separate item of work.

The bids will be compared on the basis of the Engineer's approximate estimate of quantities, which will be furnished with copies of the specifications.

No proposal will be considered unless the party making it shall furnish evidence satisfactory to the Board of Trustees of his ability to do the work, and that he has the necessary pecuniary resources to fulfill the conditions of the contract, provided such contract shall be awarded him.

Bidders are required to state in their proposals their individual names and places of residence in full.

Specifications and plans may been seen at the office of the Chief Engineer, Rialto Building, Chicago, Ill.

The said Board of Trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO,
By FRANK WENTER,
President of its Board of Trustees.

Attest:
THOS. F. JUDGE, Clerk.
Chicago, Ill., June 20. 1894. 26-8t

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., June 14, 1894.—Sealed Proposals will be received at this office until 2 o'clock p. m. on the 6th day of July, 1894, and opened immediately thereafter, for all the labor and materials required for steam heating and ventilating apparatus for the U. S. Custom House and Post Office building a Houlton, Me., in accordance with drawings and specification, copies of which may be had at this office, or at the office of the Superintendent at Houlton, Me. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. Proposals received after the time stated will be returned to the bidders. The Government reserves the right to reject any or all bids or to waive any defect or informality in any bid should it be deemed in the interest of the Government to do so. Proposals must be inclosed in envelopes, sealed and marked, "Proposal for Steam Heating and Ventilating Apparatus for the U. S. Custom House and Post Office Building at Houlton, Me.," and addressed to JEREMIAH O'ROURKE, Supervising Architect. 25-2t

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OFFICE OF THE LIGHT-HOUSE ENGINEER. Seventh District, New Orleans, La., June 2, 1894.—Sealed proposals will be received at this office until 2 o'clock p. m of Tuesday, the 3d day of July, 1894, for furnishing materials and labor of all kinds necessary for the completion and delivery of the metalwork required for increasing the height of the tower at Key West, Florida. Plans, specifications, forms of proposal and other information may be obtained on application to this office. The right is reserved to reject any or all bids, and to waive any defects. JAMES B. QUINN, Major of Engineers U. S. Army, Light-House Engineer, Seventh District. 23-4t

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U. S ENGINEER OFFICE, 34 WEST CONGRESS St., Detroit, Mich., June 28, 1894.—Sealed proposals for Power House and Office Building for the 800-ft. lock, St. Marys Falls Canal, will be received here until 2 P. M., July 28, 1894, and then publicly opened. Information furnished on application. O. M. POE, Col. Corps of Engrs. 26-3t

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UTICA PIPE FOUNDRY CO.

CAST IRON PIPE AND SPECIALS FOR WATER AND GAS.

Also flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc. CHAS. MILLAR & SON, Selling Agents, Utica., N. Y. Manufacturers of Lead Pipe and Plumbers' Materials. Wholesale Eastern Agents Akron Vitrified Sewer Pipe.

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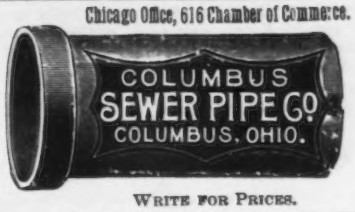
Chicago Office, 616 Chamber of Commerce.



WRITE FOR PRICES.

Smoothness of motion, absolute safety and high speed are among the good qualities possessed by **OTIS ELEVATORS.** They are built by Otis Brothers & Co 38 Park Row, New York.

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Offices, 222 & 224 So. Third St., PHILADELPHIA.

MANUFACTURERS OF

Boiler Tubes, Wrought Iron Pipe and Fittings.

Electric Railway and Light Pipe Poles a Specialty.

PROPOSALS FOR BRICK SEWER.

WILLIAMSPORT, PA.

Notice is hereby given that sealed proposals will be received by the Highway and Sewer Committee of the City of Williamsport, Pa., up to 12 o'clock noon of July 6, 1894, for the construction of an egg-shaped two-ring brick sewer, 2 ft. 6 in. × 3 ft. 9 in., on Third St., between Hepburn St. and Walnut St., a distance of 2,050 ft. This sewer is to replace an old 4-ft. circular sewer on the north side of the street; and bids are desired for the construction of the new sewer on the location of the old, and also to build the new sewer on the south side of the street and to fill up the old sewer.

Work to be built in accordance with plans and specifications on file in the office of the City Engineer.

Each bid is to be accompanied by a certified check for $1,000.

The committee reserves the right to reject any or all bids.

WM. J. DIEISBACH.
26-1t City Clerk.

PROPOSALS FOR WATER-WORKS MATERIAL.

The Board of Trustees of the Village of Kirkwood, Illinois, will receive sealed bids for all cast-iron pipe, hydrants and valves, pumping machinery and boiler, f. o. b. cars Kirkwood, also a steel standpipe erected on the foundation furnished by the village, until 7 o'clock P. M., July 12th, A. D. 1894. Specifications for the entire works may be obtained of the village clerk or consulting engineer, and plans seen at Kirkwood or the engineer's office after July 2d.

A certified check of $200 on some national bank made payable to the order of the village treasurer of Kirkwood, Ill., must accompany each bid. The village reserves the right to reject any or all bids.

C. H. MUNDORFF,
President.
R. L. EVERETT,
Clerk.
CHAS. F. STURTEVANT,
Consulting Engineer,
800 North 2d street,
St. Louis, Mo. 24-

TO PAVING CONTRACTORS.

Sealed proposals will be received by Committee on Highways of City of York, Pa., until 7 o'clock P. M., Tuesday, July 3d, 1894, for grading and paving four separate squares (approximately 15,200 square yards) with asphalt block or vitrified shale brick or block on 6-inch concrete foundation. Plans and specifications can be seen at City Engineer's office, No. 6 West Market street, York, Pa.

Each bid must be accompanied by a sample of block or brick to be used, also by a certified check of $500, drawn to order of City Treasurer of York, Pa., said $500 to be forfeited to City of York by bidder awarded contract in case he should fail to enter into within ten days after awarding.

The right is hereby reserved to reject any or all bids.

Bids are to be made out on blanks furnished at City Engineer's office and marked "Proposals for Paving." Address R. C. Boeckel, Clerk, care The P. C. Wiest Co., York, Pa.

By order of
JACOB HOSE, Chairman.
Attest.: R. C. BOECKEL, Clerk. 24-3t

NOTICE TO CONTRACTORS.

Northumberland, Pa., June 25, 1894.

Sealed proposals will be received by the undersigned at their office until noon Saturday, July 14, 1894, for furnishing the materials and constructing a gravity system of water-works for said company: 21,500 ft. 10-in., 600 ft. 8-in., 6,000 ft. 6-in., 14,500 ft. 4-in. cast iron; 12,000 ft. 8-in. vitrified pipes; and reservoir. Plans and specifications will be on file at our office.

The company reserves the right to reject any or all bids.

NORTHUMBERLAND WATER CO.
26-1t

NOTICE TO WATER-WORKS CONTRACTORS.

On the 17th day of July, 1894, the city of Kaukauna, Outagamie County, Wisconsin, will let a franchise to the lowest and best bidder for the construction of a water-works system. The city will contract for 90 hydrants. Population, 6,000; for further particulars address City Clerk, Kaukauna, Wis.

26-3t H. B. TANNER, Mayor.

U. S. ENGINEER OFFICE, NEWPORT, R. I., May 30, 1894.—Sealed proposals, in triplicate, for stonework at Stonington breakwater, Conn., will be received here until 12 M. noon on July 17, 1894, and then opened. Attention of bidders is invited to Act of Congress approved August 1st, 1892, Sections 1 and 2 (Public No. 193). Full information furnished on application. W. H. BIXBY, Captain Corps of Engineers, U. S. A. 23-4t

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FOR USE ON RESERVOIRS, HARBORS, RIVERS, IRRIGATION CANALS, ETC.

The apparatus is small, compact, simple in adjustment, easily set up. It plots automatically a continuous curve for one month, one week, or one day, as may be required. Has been used for several years on some of the Principal Reservoirs and Harbors of the United States and Mexico. Prices greatly reduced.

For circulars and information write to

STANDARD GAUGE CO., No. 24 Haven Bldg., Buffalo, N. Y.

TO WATER-WORKS CONTRACTORS.

Sealed proposals will be received at the office of the Secretary of the Board of Water Commissioners of the corporation of Grafton, W. Va., until 12 o'clock noon, July 16, 1894, for furnishing all material and performing all labor necessary for the construction of a water-works plant for the above corporation.

The work to be done embraces the following:

Part 1. Furnishing cast iron pipe, about 430 tons.

Part 2. Furnishing valves and fire hydrants.

Part 3. Hauling and laying pipes and valves.

Part 4. Constructing steel tank.

Part 5. Furnishing two 1,000,000 gallon pumping engines.

Part 6. Furnishing boiler plant, 200 horse power.

Part 7. Constructing boiler and engine house.

The Water Commissioners reserve the right to reject any and all bids.

Plans and specifications can be seen and forms of proposals secured at the office of the Secretary, Grafton, W. Va., or at the office of the engineers, Westinghouse Building, Pittsburgh, Pa., after July 1, 1894.

By order of the Board of Water Commissioners.

B. F. BAILEY, Secretary.
WILKINS & DAVISON, Engineers. 26-3t

JEFFERSON, IA., WATER-WORKS.

NOTICE TO CONTRACTORS.

Sealed proposals will be received by the City Council of Jefferson, Ia., up to 8 o'clock P. M. of July 6, 1894, for furnishing the materials and constructing a system of water-works for said city.

The works will consist of a 12 post steel tower 120 ft. high; a wood tank 30 ft. in diameter, 20-ft. staves, to be complete including frost proofing; about 1,120 ft. 10-in. pipe; 2,240 ft. 8-in. pipe; 3,300 ft. 6-in. pipe; 5,500 ft. 4-in. pipe; about 7,500 lbs. special castings, and 16 double hose hydrants.

Bids for furnishing and laying pipe must be per foot. Plans and specifications will be on file in the Mayor's office, Jefferson, Ia., and with the United States Wind Engine & Pump Co., Batavia, Ill., and Bankers Iowa State Bank, Des Moines, Ia., on and after June 10, 1894.

No bids will be received unless accompanied with a certified check on some responsible bank for $300, payable to the order of the Treasurer of the City of Jefferson, Ia.

Bids will be received for the whole or any portion of the above work, and the right is expressly reserved to reject any and all proposals or bids.

Dated at Jefferson, Ia., June 4, 1894.

HENRY HAAG, Mayor.
M. E. HALL, City Clerk. 24-3t.

NOTICE TO CONTRACTORS.

BRICK PAVEMENT.

Sealed proposals will be received by the city of Poughkeepsie, N. Y., at the Chamberlain's office in said city until 7 P. M., Monday, the 2d day of July, 1894, for furnishing and laying a vitrified brick pavement on Main street from Clover to Washington street in said city.

Each proposal must be accompanied by a certified check payable to the order of the city of Poughkeepsie, N. Y., for the sum of $500.

Specifications, form of proposal and contract may be obtained at the office of City Chamberlain.

Nine hours will constitute a day's labor and only citizens of the United States to be employed.

The right is expressly reserved to reject any or all proposals.

Proposals must be made upon forms obtained as above and must be indorsed, "Proposals for Brick Pavement."

By order of the Common Council.

JOHN J. RUDDY,
26-1t City Chamberlain.

TO BRIDGE CONTRACTORS.

The Common Council of the city of Albion, Mich., will receive sealed bids, to be opened July 2, 1894, at 7:30 P. M., for two steel bridges, also for one stone bridge. For particulars apply to F. LABERTEAUX,
26 1t City Clerk.

NOTICE TO CONTRACTORS.—Sealed proposals for constructing about six miles of pipe sewers in the village of Bridgeport, O., will be received by the Council at their office in said village until 12 o'clock at noon of July 12, 1894. Plans and profiles can be seen and specifications and form of contract obtained at the office of the Village Clerk C. W. HOWELL, Village Clerk. 26-2t

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For Other Proposals see Page XX.

NOTICE TO CONTRACTORS.

Sealed proposals will be received by the Village Board of Downer's Grove, Ill., until 8:00 o'clock P. M., July 9, 1894, for the following material and work required to complete a water-works system:

1,930 ft. of 12-in. cast iron pipe, 3,900 ft. of 10 in. pipe, 7,330 ft. of 8-in. pipe, 30 hydrants, 11 gate valves and boxes, a standpipe and ground reservoir.

Proposals will be submitted on blanks furnished by the Village, and may be for any or all material or for any or all labor, or for both material and labor, as set forth in the different sections of proposals.

All proposals must be sent to the Chairman of Improvement Committee, and be accompanied with a certified check payable to the Village Treasurer of Downer's Grove, Ill., for a sum equal to 3% of the amount of proposal, provided that no check shall be less than $50.

The Board reserves the right to reject any and all proposals.

Plans and specifications may be examined at Carpenter's drug store, Downer's Grove, Ill., or at the office of the Engineer, W. S. Shields, 100 Washington street, Chicago.

By order of the Board of Trustees of said village.

W. S. CARPENTER, President.

GEO. T. HUGHES, Clerk.

G. L. BUSH, Chairman Imp. Com.,

25-3t Downer's Grove, Ill.

WATER-WORKS AND ELECTRIC LIGHT PLANT.

Sealed proposals will be received by the Board of the Water-Works Trustees of Napoleon, O., up to noon Tuesday, July 24, 1894, for the material and construction of a complete water-works and electric light plant for the village of Napoleon, O. One brick building for the entire plant; one brick stack, 75 ft. high. Water-works machinery: two 1,000,000-gallon pumps; about 8 miles of pipe 14 to 4; 72 hydrants, etc., and two boilers. Electric machinery: two 100 HP. engines; one 60 arc light dynamo, and one 1,500 incandescent light dynamo, including first-class plant. One stand pipe 20 by 125 ft.

Information and specifications can be had of

JOSIAH KOLLER,
Secretary of Water-Works Bd.

H. C. GROSHNER, President.
J. B. STRAWN, Salem, O., Engineer.
26-2t

NOTICE TO BRIDGE CONTRACTORS.

Red Wing, Minn., June 9, 1894.

Sealed proposals for the superstructure of a bridge to be built over the Mississippi River at Red Wing will be received by the Common Council of Red Wing, Minn., at the Council rooms, until 7:30 o'clock p. m. of the 13th day of July, 1894, when they will be publicly opened and read at a meeting of the Council held for that purpose.

The work will comprise two 94-ft. deck spans, one 430 ft. through span, one 220 ft. deck span, and about 150 ft. of trestlework, all of steel, together with the necessary wooden flooring and sidewalk rails.

The work will be let on the basis of pound price for the material erected, and per thousand ft. B. M. of lumber in the work.

A check in the amount of $500, properly certified, and made payable unconditionally to the order of the city treasurer of Red Wing, Minn., must accompany each bid.

Proposals must be upon blank forms furnished for that purpose, and any not in conformity with this notice will be considered as informal and be rejected.

Plans and specifications are on file, and can be seen, and blank forms of proposals obtained, after June 25th, at the office of the Engineer, Chas. F. Loweth, 94 E. Fourth Street, St. Paul, and L. P. Wolff, City Engineer, Red Wing, and Engineering News, 1636 Monadnock Building, Chicago.

The right is reserved to reject any or all bids.

By order of the Council.

C. A. ERICKSON,
Chairman Bridge Committee.

CHAS. F. LOWETH,
Engineer. 25-2t

U. S. ENGINEER OFFICE, MEMPHIS, Tenn., June 15, 1894.—Sealed proposals, in triplicate, for furnishing brush, poles, wire, wire strand, wire rope clips and manilla rope will be received at this office until noon June 30th, 1894, and then publicly opened. All information furnished upon application. S. W. ROESSLER, Capt. Eng'rs. 25-2t

PROPOSALS FOR STAIRWAYS AND ELEVATOR GUARDS.

Sealed proposals will be received by the Board of Trustees for the Improvement of the Court House, for furnishing all material and performing all labor for the construction of "Stairways" and "Elevator Guards" in the Stark County Court House, in Canton, Ohio according to plans and specifications now on file with the clerk of said Board. All bids must be accompanied by a preliminary bond in the amount of 10 per cent. of the total amount of the proposal, and must be signed by at least two sureties.

The Board reserves the right to reject any or all bids.

L. A. LOICHOT,
25-2t Clerk.

TREASURY DEPARTMENT.—Office Supervising Architect, Washington, D. C., June 20, 1894.—Sealed proposals will be received at this office until 2 o'clock P. M. on the 19th day of July, 1894, and opened immediately thereafter, for all the labor and materials required for the brick and terra cotta floor and ceiling arches, concrete filling, terra cotta furring, etc., for the U. S. Post Office building at Worcester, Mass., in accordance with the drawings and specification, copies of which may be had at this office, or the office of the Superintendent at Worcester, Mass. Each bid must be accompanied by a certified check for a sum not less than 2 per cent. of the amount of the proposal. The right is reserved to reject any or all bids or to waive any defect or informality in any bid should it be deemed in the interest of the Government to do so. All proposals received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes, sealed and marked, "Proposal for Floor Arches, Concrete Filling, etc., for the U. S. Post Office, etc., Building at Worcester, Mass.," and addressed to JEREMIAH O'ROURKE, Supervising Architect. 26-2t

MUNICIPAL BOND MARKET.

NEW YORK, June 26, 1894.

The chief interest in the municipal bond market during the week ending to-day has centered in the disposal of the Chicago and Philadelphia issues. The opposition to the overstepping by the Chicago authorities of the statutory limit of municipal indebtedness at 5 per cent. of the assessed valuation led to the withdrawal of $210,000 of the bonds offered, so that only $1,577,000 were disposed. The discussion as to Chicago's right to issue these bonds—although it is asserted that the assessed valuation is only one-fourth of the real valuation, so that the security is all right—did not dispose brokers nor investors in their favor, so that only one New York house made a bid. This was Blair & Co., who offered 101.34 for the whole $1,787,000. Such of the bonds as were issued were awarded as follows: $446,000 water bonds, at 103.26, to N. W. Harris & Co., of Chicago, and $1,131,000 sewer and improvement bonds, at 102.83, to the First National Bank of Chicago. There were in all about a dozen bids, the best being that of Paul C. Peterson, of Chicago, who offered 104.56, but, as he only wanted $50,000 worth, none were awarded him. The bankers seemingly secured a bargain, in that about $100,000 of the bonds have since been resold around 104.25, a good price for a four per cent. bond.

The other bond sale of importance was the offering by the city of Philadelphia of a $3,000,000 loan for general purposes, and $500,000 of the Reading Subway $6,000,000 loan. This was more successful than the Chicago sale, as bids were offered for $9,088,000 of the former and $1,866,000 of the latter loan. The loans were awarded in the form of 3½ per cent bonds, at premiums placing them upon a basis of 3¼ @3.35 per cent., and to the following banking houses and institutions: W. H. Newbold's Sons & Co., of Philadelphia, and Harvey Fisk & Sons, of New York, $2,334,000; the Pennsylvania Company for Insurance on Lives, $1,000,000; the Girard Life and Trust Company, $250,000; L. & F. Scott, $16,000—this award being on a 3 per cent. basis. The $3,000,000 loan is in 20 series of $150,000 each, and the $600,000 loan in two series of $300,000 each.

These sales do not actually reflect the course of the municipal bond market, but furnish a pretty sure index as to the rating put by people who know on the credit of the two cities in question. In contrast to the difficulty hedging around the Chicago bond sale was the free-and-easy disposal to-day by the Comptroller of the city of New York of over $1,000,000 bonds, awarded as follows: $542,533 3½ per cent. schoolhouse bonds, to Blake Bros. & Co. and Vermilye & Co., at 104.04 and interest, and $500,000 3½ per cent. dock bonds to the same buyers at 106.03 and interest, there being four other bidders. These are truly splendid prices.

Coming back to the municipal bond market in general it is noted that the market is getting bare of really desirable issue, and that is why first-class bonds like the New York city 3½ and 3¼ per cent. bonds just sold command such full and, it might be said, exorbitant prices It is estimated by dealers in municipal bonds that about $12,000,000 of new issues were placed in the last 30 days, yet the demand for good bonds is rather in excess of the supply. The point is made that the reason New York city bonds are about the only ones that have not advanced in unison with other municipal securities—present high prices are really not above what have ruled for months—is that local savings banks, under the new law, are allowed to invest in the bonds of other cities that can be obtained on a better basis than New York bonds.

Continued easy money assures the continuance of present good figures. The first of July, too, will see the distribution in New York, Boston, Philadelphia, Baltimore and Chicago of about $125,000,000 in interest and dividend payments, and this immense sum of money will be added to the already large, idle amounts of capital seeking investment. This must help to buoy up quotations of municipal bonds, but any activity in the money market will see the employment of all these idle funds in making loans, and the restriction of the demand for municipal bonds must result in lower prices.

The following quotations will indicate to contractors and other interested parties the credit obtainable by various towns and cities:

MUNICIPAL BONDS.

	Price.
County of Brazoria, Tex., 6s	103½
County of Bexar, Tex., 6s	107¾
City of Meridian, Miss., 6s	107¼
School District of Brainerd, Minn., 6s	108¾
County of Fergus, Mont., 6s, Gold	106
County of Park, Mont., 6s, Gold	109¼
Town of Knightstown, Ind., 6s	111¼
City of Bethany, Mo., 6s, Gold	105¾
City of Bartow, Fla., 20-year 6s	102
City of Troy, Ala., Water 30-year Gold 6s	100
City of Pueblo, Col., Gen. Fund Gold 6s	112
County of Flathead, Mont., 20 year Funding Gold 6s	107⅝
County of Snohomish, Wash., Gold 6s	107¾
School District No. 6, Kings Co., N. Y., 6s	108½
Town of New Utrecht, Kings Co., N. Y., 5s	101¾
School Dist. No. 2, Kings Co., N. Y., 5s	105¼
State of Idaho Wagon Road 5s	111½
City of Omaha, Neb., 5s	111
City of Galveston, Tex., 5s	101½
City of Newport, Ky., 5s	101½
City of Dayton, O., School 5s	107½
City of Toledo, O., Gen. Fund 5s	110¾
City of Springfield, O., School 5s	104¾
County of Jefferson, O., Road 5s	101½
County of Portage, Wis., Refunding 5s	107¾
City of Sheldon, Ia., School 5s	101½
Youngstown, O., 5s	108
County of Hennepin, Minn., 4½s	106⅜
School Dist. of Sioux City, Ia., 4½'s	101
City of Chicago, Ill., 4's Gold	104¼
City of Chicago, Ill., Water Loan Gold 4's	104½
City of Brooklyn, Pub. Market 4's	110.43
School Dist. No. 1, Suffolk Co., N. Y., 4's	113
Town of Greenburgh, Westchester Co., N. Y., Road 4's	103½
City of Auburn, N. Y., 4's	108⅞
City of Cleveland, Ohio, 4's	104⅝
City of Manchester, N. H., 4's	106½
City of Everett, Mass., 4's	107
Town of Methuen, Mass., 4's	107
City of Waterbury, Conn., 4's	105⅛

RAILROAD STOCK MARKET.

NEW YORK, June 26, 1894.

Wall street has been chiefly occupied of recent days in criticising the action of the New York Central Railroad Company's Board of Directors in declaring a regular quarterly dividend of 1¼ per cent., when it had not been earned by about $711,000. As the whole dividend only calls for $1,118,000, it will be noticed that over half of the amount to be distributed among stockholders will be borrowed money. This is the kind of "conservatism" that has brought half the prominent railroad systems of the country into receiver's hands; that has taught investors the unreliability of railroad managements and that fully warrants the distrust generally held abroad of "Yankee rails." A great hue and cry was raised some weeks ago when the Chicago, Burlington & Quincy declared a regular dividend, which wasn't earned, out of the surplus it had accumulated in recent years. The recent determination of the Northern Pacific receivers to borrow $1,000,000 wherewith to pay coupons due July 1 on the first mortgage bonds of the road was also regarded in many quarters as reckless financiering. Yet nearly all the financial writers are disposed to praise the New York Central people for their policy of distributing among stockholders money that was not earned, the excuse being made that such action will tend to restore confidence and that the deficit will easily be made up in the future. More than one road, however, has come to grief through banking on prospects, and the custom of borrowing money to pay dividends cannot be too strongly condemned. The name Vanderbilt has hitherto been synonymous with safe management, and it seems a pity that the New York Central directors should resort to this desperate measure merely to uphold stock market quotations. This is said advisedly, in that the company still has for sale some $2,500,000 of the new capital stock authorized last year. As this cannot be disposed of at less than 100, and as ruling stock market quotations are only around 95½ to 96, some hint as to the real animus of the New York Central management's last movement is furnished. Naturally the stock has been weak on the revelation of bad earnings and deficits, and not much good feeling has been created in its behalf. The other Vanderbilt roads—the Lake Shore Michigan Central and Canada Southern—have all also declared their regular semi-annual payments, but, as they reported surpluses after providing for dividends, despite big decreases in gross receipts, they have aroused no discussion.

The Atchinson reorganization plan has at last been made public, and its provisions have brought a storm of no mean proportions around the ears of the committee having the matter in charge. Already decided opposition has manifested itself, and the failure of the plan, unless amended, is predicted in many quarters. What is objected to most of all is the provision of the plan whereby stockholders are to pay an assessment of $12 per share of capital stock, and at the same time surrender control of the road for five years at least to the income and general mortgage bondholders. Naturally, many stockholders decline being mulcted in this fashion, and, fancying that paying an assessment would be throwing good money after bad, have liquidated their holdings in such free and wholesale fashion that Atchison stock, that once sold at 120, has gone down below 5.

The calling of so large an assessment on Atchison, following the big assessments on Richmond Terminal and New England, has created a very depressed feeling on what is now known as the "hospital" group. Wall street now realizes that Union Pacific, Northern Pacific and Reading cannot be rehabilitated without similar large sacrifices on stockholders' parts, and they have been letting go their holdings in sufficiently large quantities to bring about a serious reaction in quotations. Estimates have it that Union Pacific stockholders must "shell out" $25 a share, that Northern Pacific will call for $15 a share and that Reading stockholders cannot escape with less than $10 a share in addition to what the income bondholders will be asked to furnish. This is not encouraging to people who have seen their holdings decline 30 to 40 points in value; and the "hospital" stocks are lower than ever.

The railroad stock market in general has been much more satisfactory. The big advance in the price of wheat has been of the greatest benefit to the Granger shares, and St. Paul, Rock Island and Burlington have all manifested a strength that promises much in the way of improved quotations. The settlement of the big bituminus coal miners' strike, so long a threatening cloud on the financial horizon, eliminates a feature from the situation of depressing import, and inaugurates an era of revived commercial idustry that is already beginning to be reflected in railroad earnings. Were it not for the uncertainty surrounding current tariff legislation, all conditions would be propitious to the inauguration of a long continued niil movement. Money is plentiful and bids fair to continue so, crop reports are favorable, business interests are cheering, and excepting the delay in putting through the tariff bill, so decided a check to commercial activity, Wall Street finds ample warrant for its belief that higher prices are at hand.

Railroad stocks.	Closing prices. June 26
Alton & Terre Haute	32
Atch., Topeka & Santa Fé	5⅛
Baltimore & Ohio	69
Canada Southern	50
Ches. & Ohio	16¾
Chic., Burl & Quincy	77⅛
Chic. & Northwestern	165¼
Chic., Mil. & St. Paul	59¼
Chic., Rock Island & Pac.	68⅛
Clev., Cin., Chic. & St. Louis	35½
Del., Lack. & Western	160¼
Delaware & Hudson	129
Lake Shore & Mich. South	132
Louisville & Nashville	44½
Missouri Pacific	26½
Missouri, Kansas & Texas	12½
Mobile & Ohio	18
New Jersey Central	106¼
New York Central	97⅝
New York & New England	8
N. Y., New Haven & Hartford	175–180
N. Y., Chic. & St. L., 1st pfd.	60
N. Y., Lake Erie & Western	12¾
N. Y., Ontario & Western	14¼
New York, Sus. & Western	14½
Northern Pacific	3½
Northern Pacific pfd.	11
Phil. & Reading	15¼
Richmond Terminal	10⅝
St. Paul & Omaha	34¾
Southern Pacific	18⅞
Texas Pacific	8⅛
Union Pacific	10⅜
Wabash pfd	13⅝
Wheeling & Lake Erie	10⅜

BOSTON RAILROAD STOCKS.

	June 26.
Boston & Albany	204
Boston & Maine	145
Fitchburg	70½
Old Colony	179

PHILADELPHIA RAILROAD STOCKS.

	June 26
Lehigh Valley	37
Pennsylvania Railroad	48⅝

In this Issue: Results of the Budapest BRIDGE COMPETITION. — The Niagara Falls CONVENTION of the Am. Soc. C. E.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

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SEE ADV. PAGE XXXIII.

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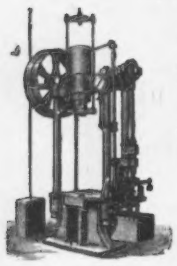

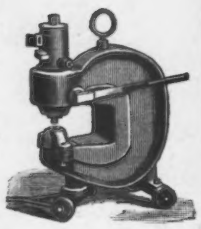

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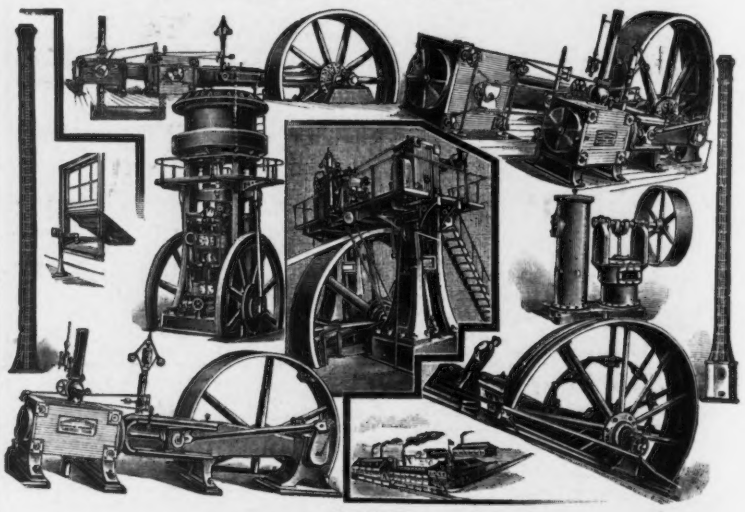

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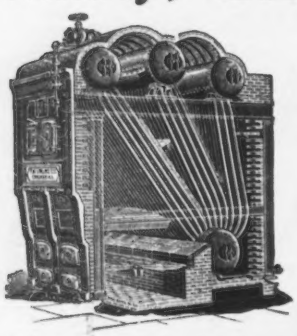

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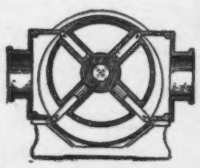

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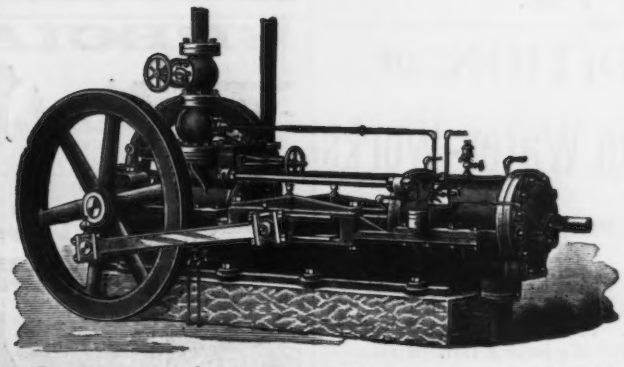

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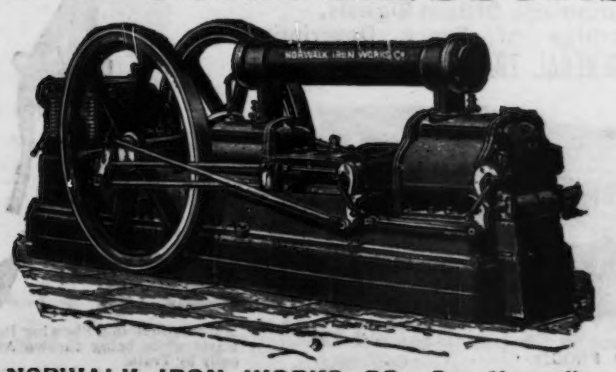

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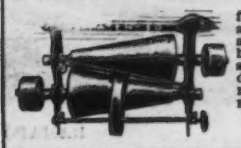

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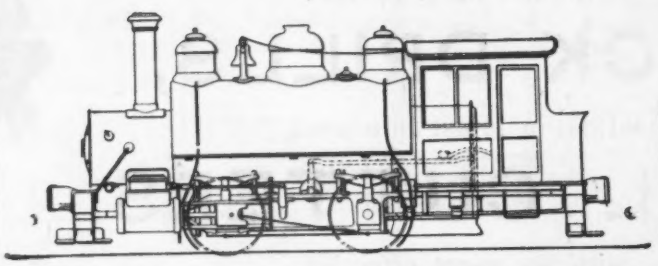

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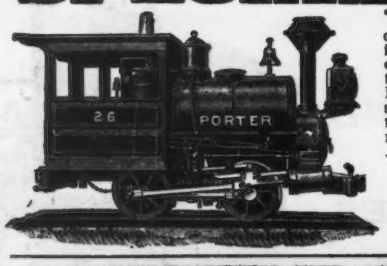

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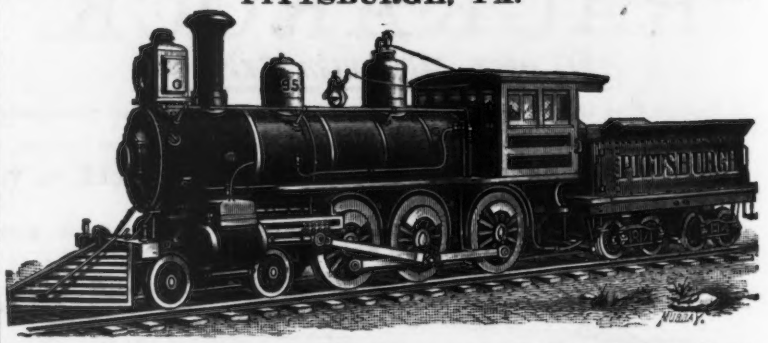

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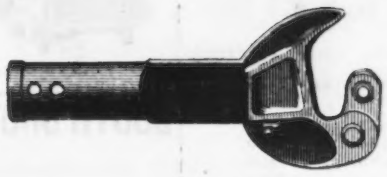

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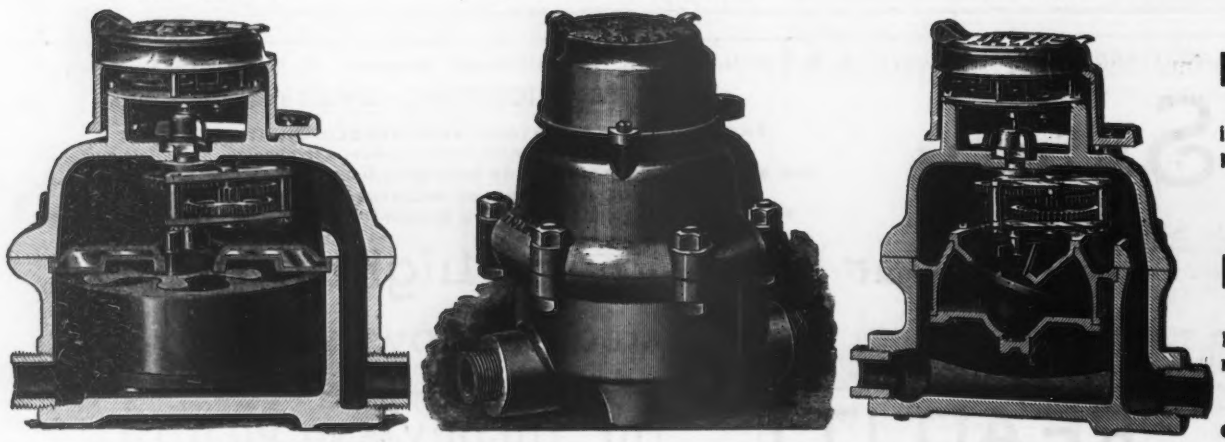

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NATIONAL METER CO.
vs.
THOMSON METER CO.

Circuit Court of the United States.
District of New Jersey.

DALLAS, CIRCUIT JUDGE:

This is an action in equity brought to restrain the infringement of Letters Patent No. 379,805, granted to the complainant, as assignee of L. H. Nash, March 20, 1888, for improvements in water meters.

The only claims of which this infringement is charged are the 15th and 17th, which read:

"15. In a water meter, a piston formed of hard rubber and having a motion of nutation, substantially as described, combined with a skeleton of strengthening material—such as steel wire—substantially as set forth."

"17. In a water meter, a piston formed of hard rubber, combined with a skeleton of strengthening material—such as metal—substantially as and for the purpose set forth."

These claims are, prima facie, valid; and are presumptively to be taken to mean what their language, which is not ambiguous, naturally imports. The defendant's attack upon them has neither established that they are invalid, or that the scope of either of them, as expressed, must be limited by construction. The defense of anticipation has wholly failed. Careful examination of the proofs, and especially of the several prior patents referred to, has convinced me, notwithstanding the able argumentative review of those patents submitted on behalf of defendant, that both claims should be maintained, and in accordance with their respective terms. The defenses, too, of lack of invention, of utility, and of patentable combination, are alike devoid of support. Nothing has been shown as to the prior state of the art or as to the knowledge of those acquainted with it, to sustain the allegation that what this patentee did, any skilled mechanic, familiar with the general subject, would naturally and spontaneously have done. On the contrary, it is manifest, I think, that in combining a metal skeleton with the hard rubber of the piston, Nash not only attained a result which was highly useful, but did so by means which were not merely novel, but quite obscure and very far from being obvious. The doctrine of aggregation has no applicability. The elements of the combination claimed—a piston of hard rubber, and a skeleton of strengthening material—do not act independently, each in its own characteristic way, but are so united as to form an integral organism, by which a new and useful result, due to their co-operation, is accomplished; and this constitutes a true combination. The infringement alleged has been proved. The testimony of Dr. Morton, and the experimental tests made and recounted by him, fully satisfy me that the disc-shaped skeleton of the defendant is identical, in the sense of the patent law, with the ring-shaped skeleton shown in the patent. They are not, in form, the same, but they both perform the same function, and the only difference in their action is one of degree.

A decree for the plaintiff, in the usual form, will be entered.

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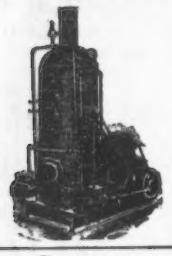

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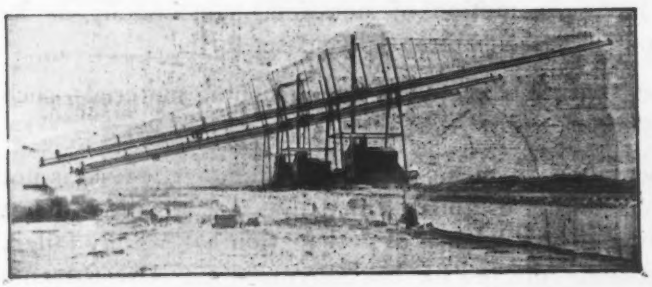

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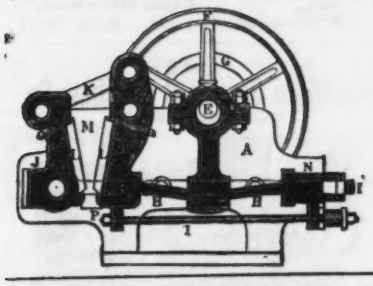

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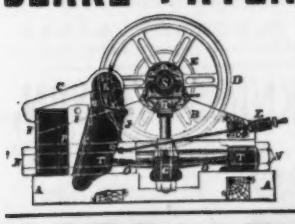

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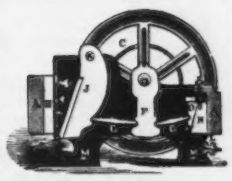

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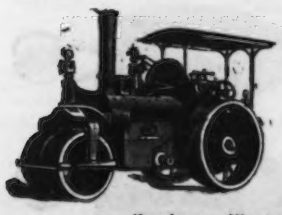

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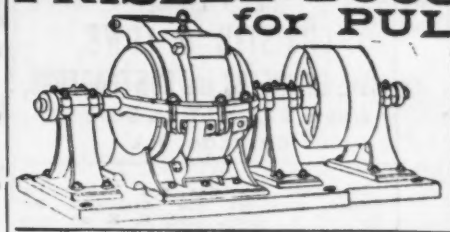

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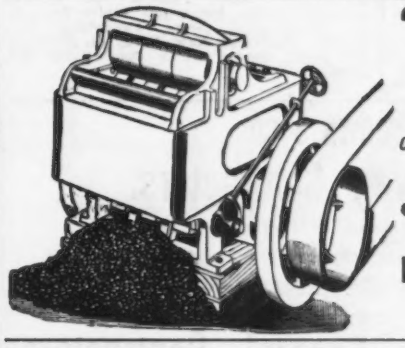

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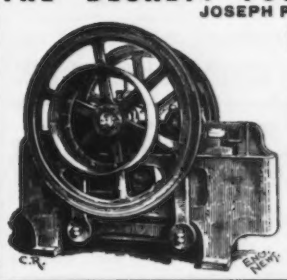

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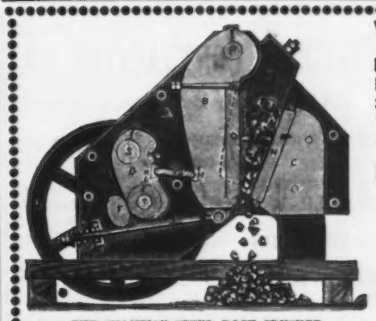

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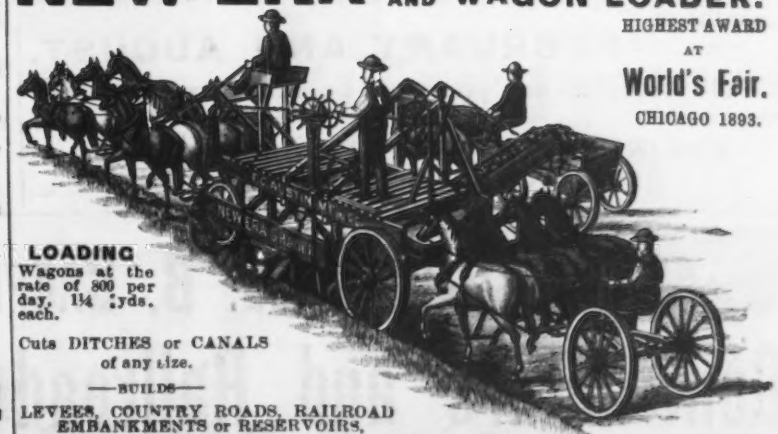

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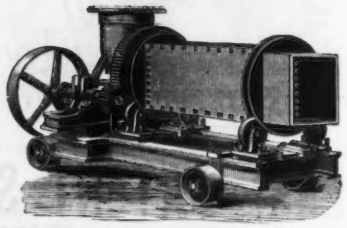

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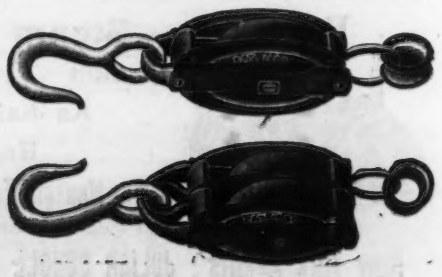

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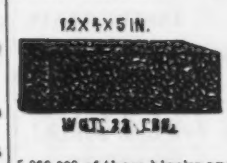

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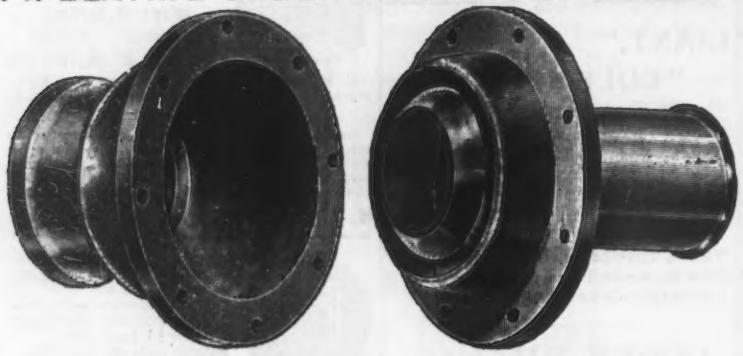

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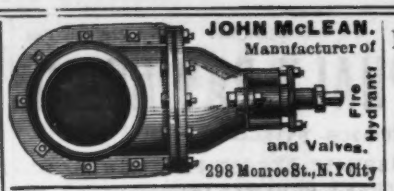

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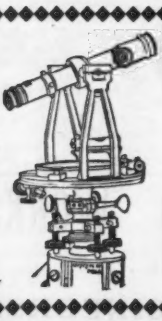

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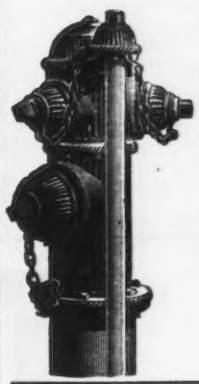

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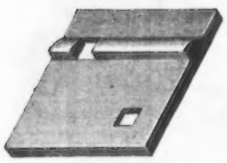

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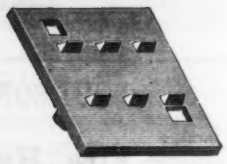

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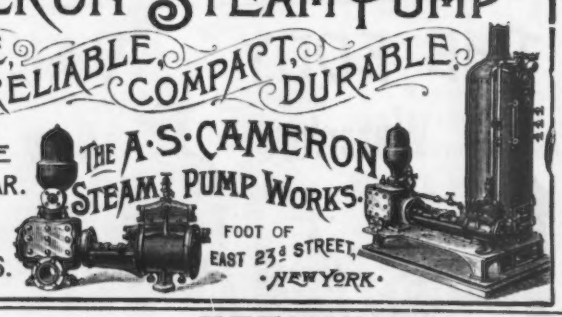

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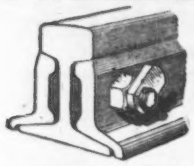

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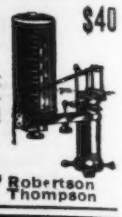

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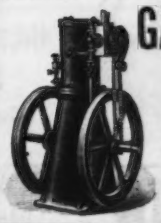

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First.—For intake pipe, crib, settling well and connections.

Second.—The water-works building, chimney, pump and boiler foundation.

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Fourth.—Pumping engines erected on foundations, and all piping and connections complete, to the outside of water-works building.

Fifth.—The distribution system of mains, fire hydrants and valves.

Plans and specifications for the work to be done are on file in the office of the City Clerk of the City of Waukegan. Detail plans, specifications and instructions to bidders can be obtained of said City Clerk or of George W. Sturtevant, Consulting Engineer, No. 804 Chamber of Commerce, Chicago, Ill., on and after June 25, 1894.

A certified check of five hundred (500) dollars must accompany each bid for each part of the work above described, and the City Council reserves the right to reject any and all bids.

HENRY THACKER, City Clerk,
June 15, 1894. Waukegan, Ill.
25-2

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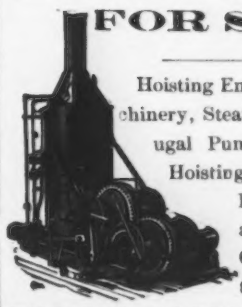

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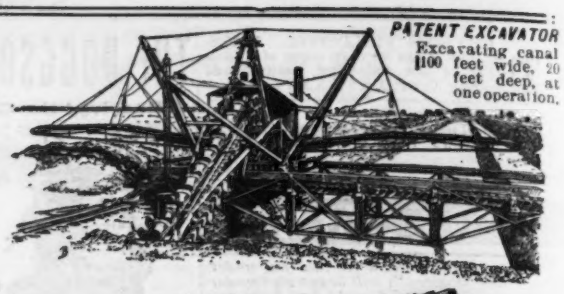

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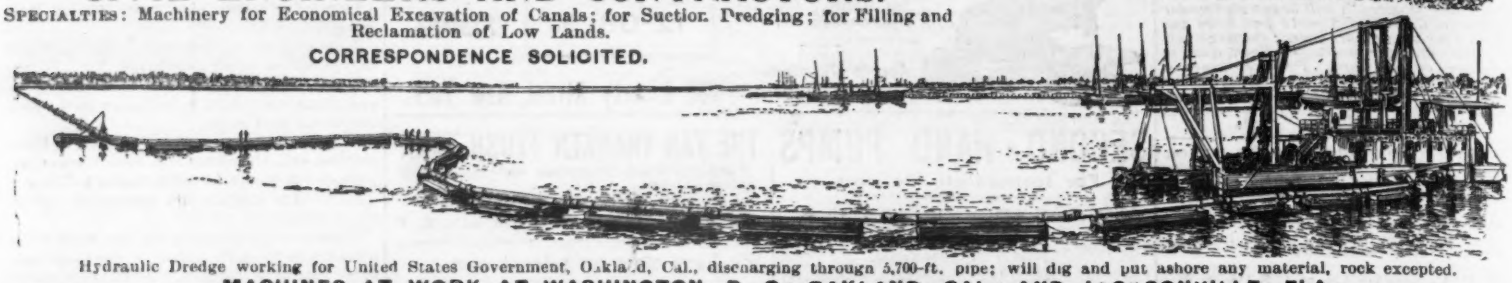

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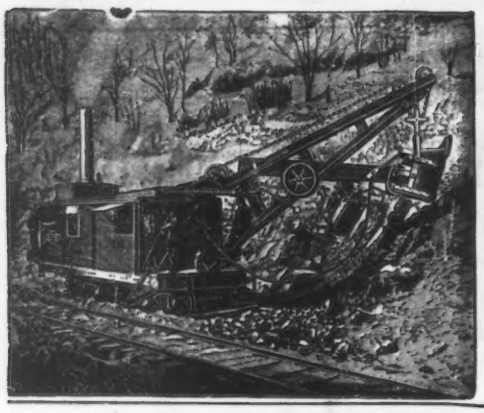

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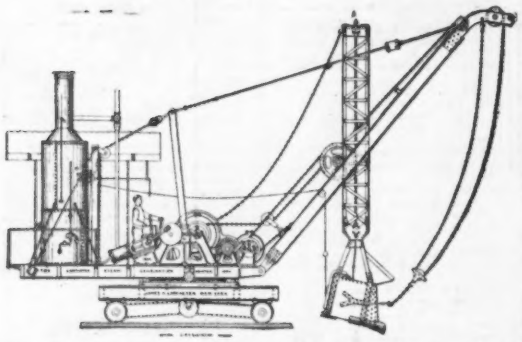

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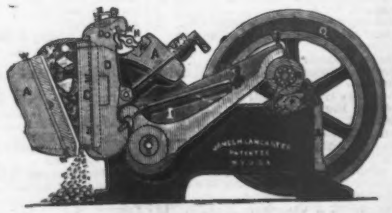

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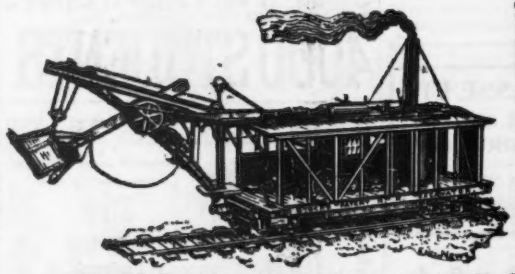

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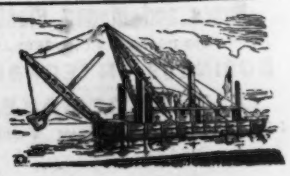

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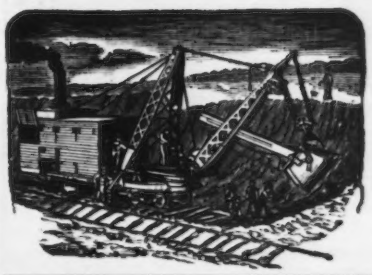

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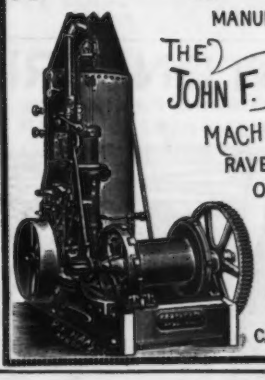

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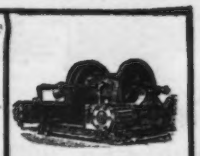

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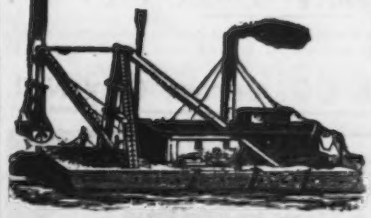

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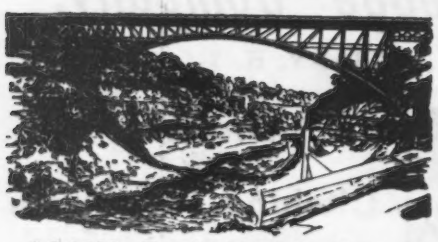

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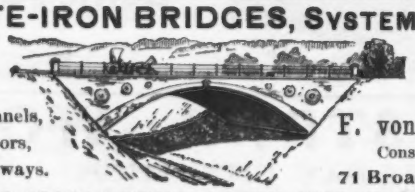

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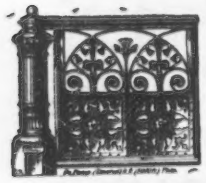

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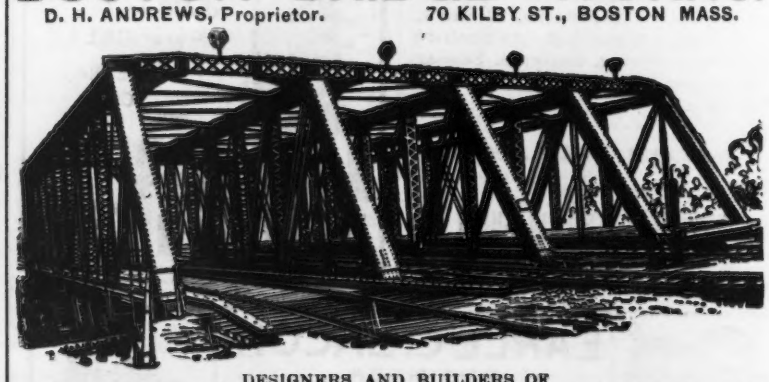

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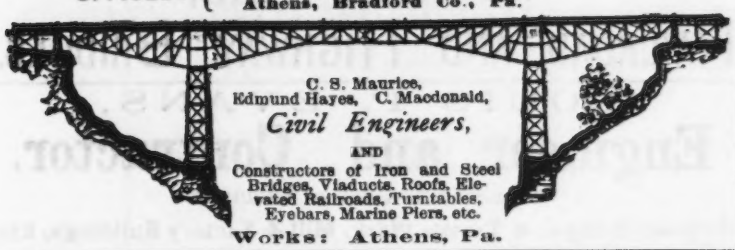

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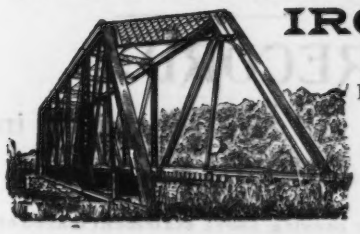

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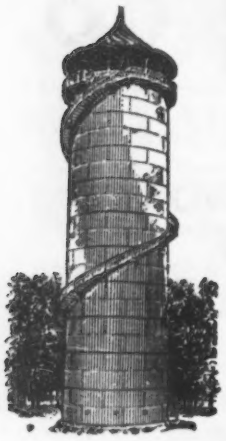

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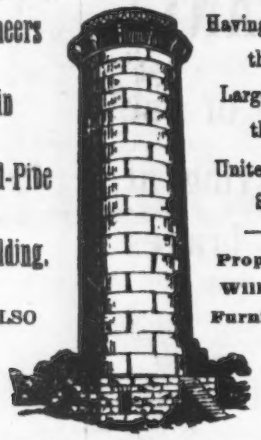

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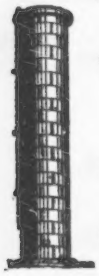

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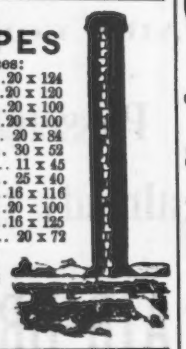

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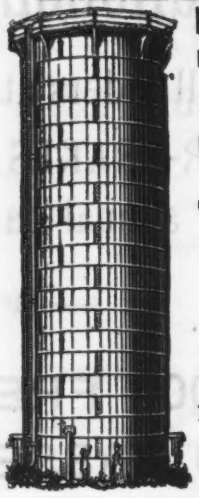

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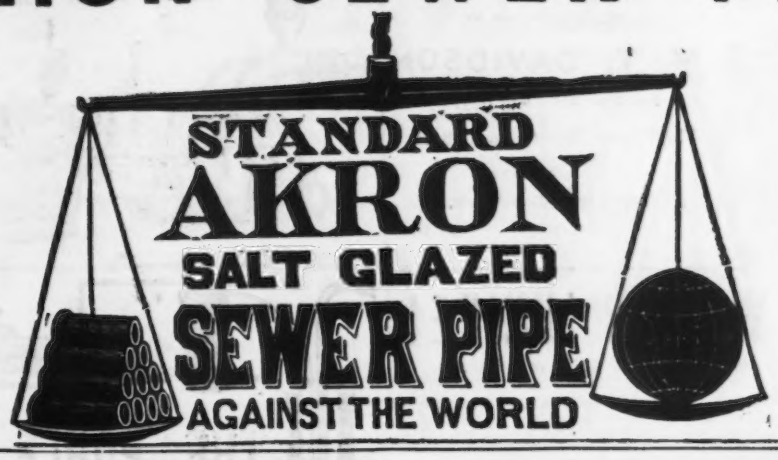

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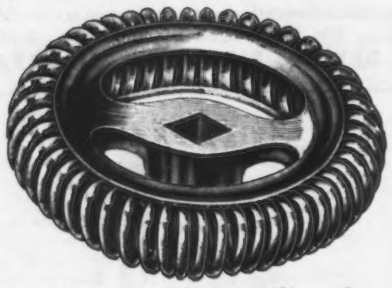

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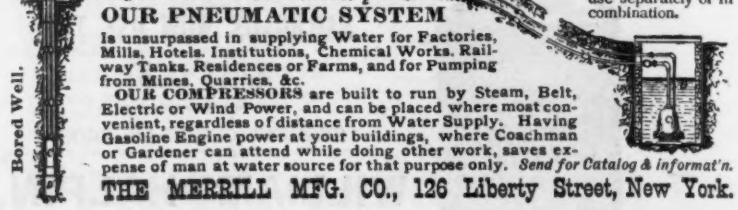

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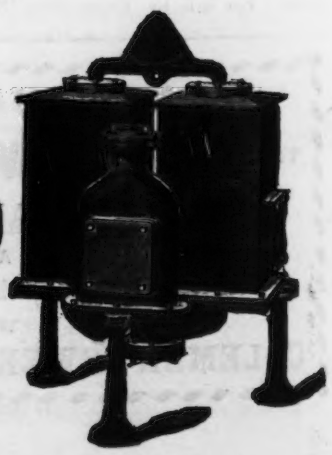

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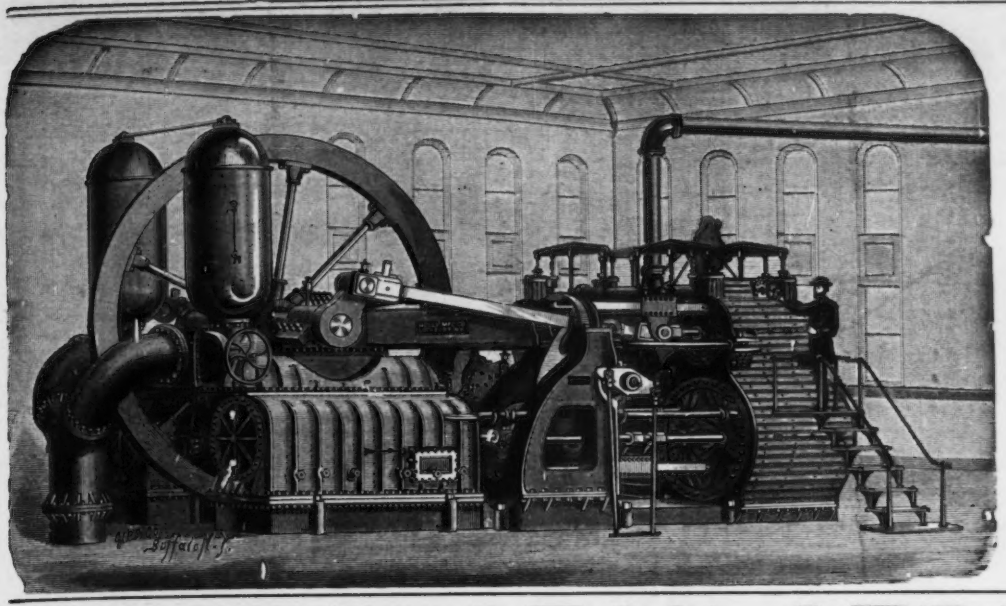

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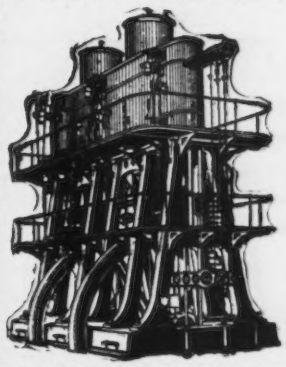

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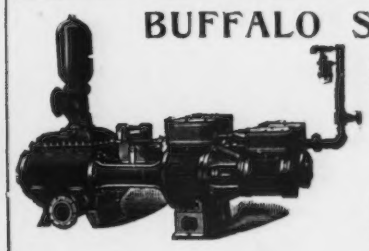

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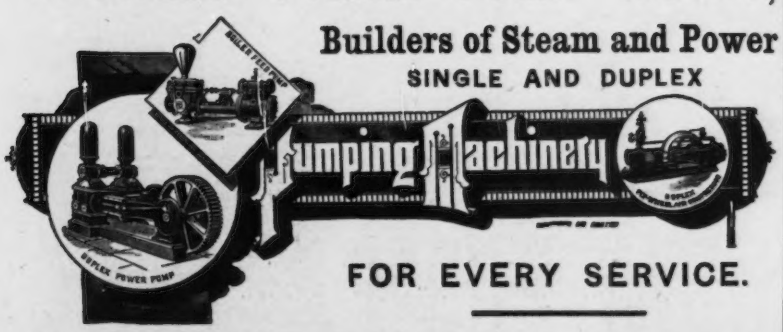

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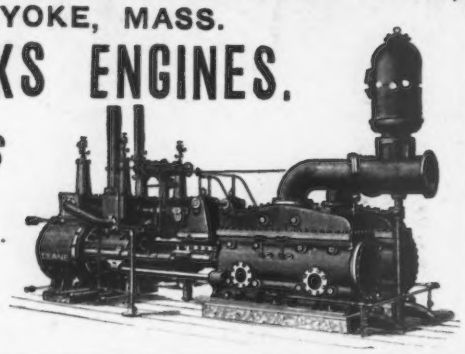

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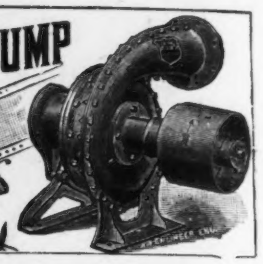

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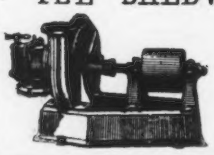

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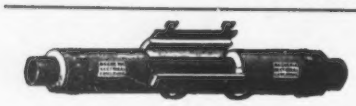

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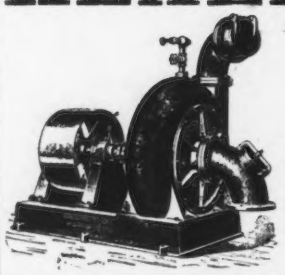

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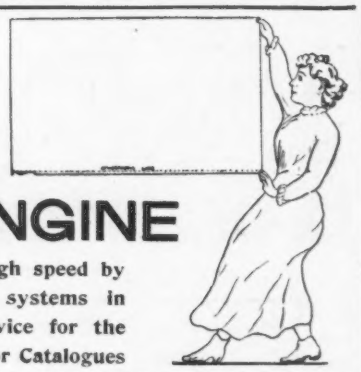

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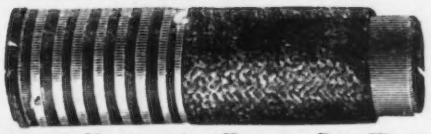

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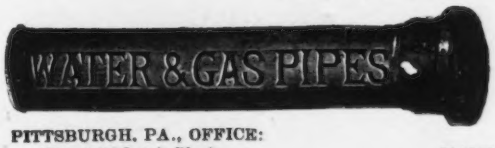

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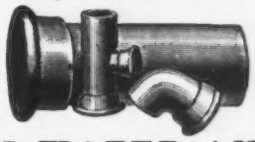

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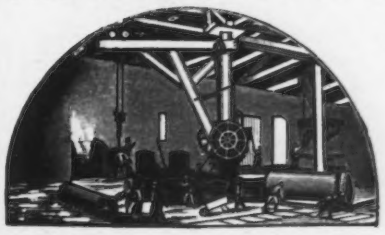

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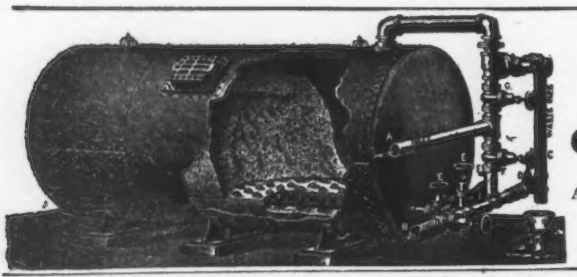

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